Computers, talk and learning : using computers to help coach reasoning through talk across the curriculum

Thesis

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Computers, Talk and Learning: using computers to help coach reasoning through talk across the curriculum

Rupert Wegerif
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Abstract

The main theme of this thesis is the role of computers as a support for reasoning through talk in the classroom. A second, closely linked, theme is the role of reasoning through talk in general intellectual development.

In the first part of the thesis the two areas of the teaching of thinking skills and the use of computers as a support for cooperative work in classrooms are explored through critical reviews of the literature and through two empirical studies. The findings of this exploratory research lead to the development of a theoretical framework for the use of computers in classrooms. This theoretical framework consists of the characterisation of a type of talk that is effective in promoting general intellectual development, a model of the structure of educational activities in which groups of children work with computers and a set of principles for the design of software to support reasoned discussion.

In the second part of the thesis the theoretical framework is explored and tested through the development and implementation of an intervention programme. A new methodology is developed to evaluate this intervention programme integrating a quasi-experimental method with both qualitative discourse analysis and computer-based discourse analysis. The findings of the evaluation support four key hypotheses which emerge from the theoretical framework. First, that there is a link between the coaching of reasoning through talk and performance on tests of general reasoning ability. Second, that the quality of computer-supported collaborative learning can be enhanced through the off-computer coaching of exploratory talk. Third, that group work at computers can in turn be used effectively to extend an educational programme designed to coach exploratory talk across the curriculum. Fourth, that computer-based collaborative learning can be used to integrate active peer-learning with directed teaching. These findings have significant implications for educational theory and practice.

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I am also very grateful to **Neil Mercer**, my second supervisor, for his inspiration and encouragement and for his generosity in drawing me in to participate as a colleague in his own research work.

Anyone reading this thesis will recognise that both the design and the success of the main study owed a very great deal to the input of the class-teacher, **Lyn Dawes**. I am very grateful to Lyn for all her help.

Many people have contributed comments on work that appears in this thesis. I would like to thank them all but particularly those who were kind enough to read the whole thing: **Richard Joiner, Anne Jones, Karen Littleton** and **Tim O'Shea**. A special thanks also to **Denise Whitelock** who read much of the thesis and was very helpful and to **Martyn Hammersley** for taking the time to comment on my chapter on methodology.

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Contents

Appendix E Chapter 9

List of figures

List of tables

Key to transcriptions

Several of the chapters present sequences of dialogue, together with contextual information in parentheses concerning what the speakers were doing. All the names of the children have been altered to protect their identity. The transcripts have been presented as readably as possible with the following two transcript conventions:

(...) undeciphered speech.

... unfinished or interrupted turn.

Chapter 1 Introduction

1.1 Motivation of this thesis

Computers are now an established part of formal education. Crook, in a recent review of computer use in education, writes that 'most British classrooms will have reliable access to at least one machine' (1994, p 1). The National Curriculum guidelines for England and Wales (DFE, 1995) state that pupils should have the opportunity to use computers in all the core curriculum subject areas. However, despite the general acceptance of computers in classrooms, there remains considerable uncertainty and debate over how best to use them. Underwood and Underwood report that in many cases computers are underused because teachers claim that they 'don't know what to with them' (1990, p 16). Crook's review of the evidence on the impact of computers in school education suggests that computers are often used in a way 'decoupled from the mainstream of classroom life' (1994, p 29). Crook claims that the limited use of computers in classrooms stems partly from the inadequate way their educational role is often conceptualised.

One possible role for computers in the classroom is as a support for collaborative learning. According to research quoted by Crook (*ibid.* see also Light, 1993; Underwood and Underwood, 1993; Joiner 1993; and Issroff, 1995) computers in schools are most often used by small groups of children. He writes that while this is partly because of the short supply of computers it is also due to the widespread belief amongst teachers that collaborative work at the computers can improve communication skills and support collaborative learning. Light (1993) surveys a range of studies to conclude that there is indeed evidence that the use of computers has the potential to enhance collaborative learning. However Light (*ibid.*) is cautious about accepting this evidence, pointing out that it comes mainly from experimental studies the findings of which might not transfer to classroom

practice. He concludes that more research is needed on computer group work in the context of real classroom practice. Since Light's survey the Spoken Language and New Technology (SLANT) project, a major study funded by the Economic and Social Research Council (ESRC), has explored group work at computers in natural classroom settings using observational methods (Mercer, 1995a; Fisher, 1993; Scrimshaw, in press; Wegerif, in press, b). Teachers and researchers involved in that project were, in the main, disappointed at the quality of the collaborations they observed and one of their recommendations in the final report (reported in Mercer, 1995a) was that effective strategies for collaboration should be encouraged in off-computer activities. The results of a further ESRC-funded research project – Group Work with Computers – (Hoyles, Healy and Pozzi, 1994) confirms that just sitting children together at a computer does not ensure effective collaboration. Hoyles *et al.* (*ibid.*) suggest that a multitude of factors, including 'intra-personal and inter-personal variables', the task set up, the software and organisational structures, affect the success of computer-supported collaborative learning and they warn against any over-simplification.

This thesis responds to the issues raised by these recent studies. It takes up Crook's call for the need to re-conceptualise the role of the computer in the teaching and learning process. At the same time it offers practical guidelines on how teachers can best use educational software in the classroom. It continues the work of the SLANT project by following up the suggestion that effective communication should be taught to children before they are asked to collaborate together on the computer. It also addresses many of the issues raised by Hoyles *et al.* (*ibid.*) through the evaluation of an intervention programme that included the developing and testing of guidelines for software design, the design of a pedagogic framework and also the fostering of educationally effective intra-personal and inter-personal relationships. In sum, this thesis presents research which is relevant to an area of current debate and which has important practical implications.

1.2 Evolution of the research question(s)

This research began with the very general question of how best to use computers in education and then narrowed to the question of how to use computers to encourage 'higher order thinking skills', understood as the capacity to reflect, question and learn autonomously. In the course of the research this second question evolved to become the question of how best to use computers to encourage and support the use of exploratory talk by children across the curriculum. The educational and conceptual arguments for this move from 'thinking skills' to 'exploratory talk', as well as explanations of what is meant by these terms, are presented in the first chapters of the thesis. The central aim of the thesis was eventually expressed through three very specific research questions which the main study was designed to resolve:

- Can the quality of children's interactions when working together at computers be improved by coaching exploratory talk?
- Can computers be used effectively to support the teaching and learning of exploratory talk?
- Can computer supported collaborative learning integrate peer learning with directive teaching?

In answering these very specific questions, the more general question of how best to use computers in education is not forgotten. Although designed to focus on these specific questions, the main study was also designed to shed light on the more general issues which had led to their formulation, including the significance of exploratory talk to intellectual development and the role of the computer in the whole teaching and learning process.

1.3 Overview of the thesis

The structure of the thesis reproduces the temporal order of the research it describes and so reflects the evolution of the research question(s) outlined above.

The thesis is divided into two main parts. The first part describes exploratory research into the nature of general thinking skills and into children's collaborative learning with computers. This research is used to develop a theoretical framework linking an interpretation of the role of exploratory talk in intellectual development with an interpretation of the role of computers in the teaching and learning process. The second part of the thesis describes how the theoretical framework developed in part one is applied in the design of an educational programme incorporating computers (EPIC). The evaluation of this programme concerns both its educational value and its implications for the validity of the framework which produced it.

Chapter 2 is a critical survey of relevant aspects of the literature on rationality, cognitive development and the teaching of 'thinking skills'. This leads to the definition of 'communicative rationality' as a situated way of using language that embodies much of what is meant by general thinking skills. It also leads to a model of intellectual development as a process which occurs through induction into communicative rationality.

Chapter 3 presents an empirical study into a thinking skills programme in a state primary school. The programme was loosely based on the 'Philosophy for Children' method developed by Matthew Lipman (1985; 1991) and consisted of teacher led discussions on themes emerging from a children's story book. Analysis based on transcripts shows that the essential method of the programme is coaching a form of communicative rationality specific to the classroom situation. It also demonstrates how this way of using language leads to the emergence of greater understanding amongst the participating children. Having shown the

success of a teacher-led approach to coaching communicative rationality in the classroom, the analysis highlights some specific limitations with this programme which suggest a possible role for the use of computers.

Chapter 4 reviews the literature on the role of the computer in promoting thinking skills and the literature on computer supported collaborative learning. It concludes with a detailed specification of the type of talk which has emerged from empirical research as the best type for promoting shared learning in face to face collaborations. This type of talk is called 'exploratory talk' after Barnes (1976) and Mercer (1995a; 1995b).

Chapter 5 looks at the quality of children's talk in collaborative learning around computers through further empirical study. Transcripts of the talk of children working together in small groups around a variety of computer software in normal classrooms were available from the Spoken Language and New Technology (SLANT) project (a brief background to this project is provided in the chapter). A method for exploring these transcripts stored as electronic text is developed based on the link between exploratory talk and certain key words indicative of reasoning such as 'because'. This method is used to analyse the data and facilitate an investigation of the relationship between software design features and the incidence of exploratory talk. This analysis of the SLANT data is also used to develop a theoretical description of the interaction between small groups of children and the computer.

Chapter 6 begins the second part of the thesis by taking up all the conclusions of the exploratory phase of the research and using them to construct both a general approach to the use of computers in education and a specific educational programme incorporating computers (EPIC) to illustrate and evaluate this general approach.

Chapter 7 discusses the methodological issues involved in developing a strategy to evaluate the programme. The actual methods used are presented and situated in the context of a critical discussion of different traditions in educational research. Methods are developed for both evaluating the quality of children's talk and for relating process and product in studies of collaborative learning.

Chapter 8 and **Chapter 9** present the findings of the evaluation of the EPIC. Chapter 8 focuses on an analysis of the change in the quality of the talk of the children over the eight week period of the EPIC using transcripts of their talk on a group reasoning test given both before and after the EPIC. This qualitative change is related to the quantitative change in test results. Chapter 9 focuses on the quality of the children's talk at the computer-based exercises. The talk of target class children on the computer is compared to that of children doing the same exercises without having been coached in exploratory talk and to the talk of children from the target class working off-computer on exercises with a similar educational objective to the computer exercises.

Chapter 10 presents the main contributions of the thesis and draws out their implications for educational practice. Some of the limitations of the research are discussed. Possible future research projects are outlined.

1.4 Publications and conference papers based on the research described in this thesis

The research described in this thesis has been the basis for three refereed journal articles and a number of other publications. A version of Chapter 5 on the role of more directive software in collaborative learning has been accepted for the *Journal of Computer Assisted Learning* (Wegerif, in press, b). A version of the theory of the role of computers in a discourse-based approach to education presented in Chapters 2, 4 and 5 has been accepted for publication by *Language and Education* (Wegerif and Mercer, in press). A summary of the methods and results reported in Chapter 9 has been accepted for publication in *Computers and Education*. A version

of Chapter 3 is in the proceedings of the International Conference on Computers in Education held in Taiwan in December 1993. A version of Chapter 4 is due to appear as a chapter in a book edited by Peter Scrimshaw (Wegerif, in press, a). A summary of the evaluation results described in Chapters 8 and 9 appear in the proceedings of the 6th International Conference of Problem Solving Across the Curriculum (PSAC'95) held in Rochester, New York in June 1995. Papers based on Chapter 6 and on Chapter 7 were given in two separate talks at the conference of the European Association of Research on Learning and Instruction held in Nijmegen in August, 1995.

Part I

Exploratory research

Overview

Part I of the thesis reports on theoretical and empirical research into the nature of general thinking skills, how these can be taught and learnt and the role of the computer in that teaching and learning process. These chapters develop hypotheses and practical educational guidelines which are tested in the second part of the thesis.

Chapter 2 The debate about thinking skills

2.1 Introduction

This chapter takes up what Weinstein (1992) calls 'the great debate' about whether general thinking skills exist and if it is possible to teach them. Various lists of general thinking skills exist (e.g. Ennis, 1987; Lipman, 1985; Paul, 1987; Coles and Robertson, 1989). Ennis, for example, includes generalising, inferring, evaluating reasons and being able to pursue a line of argument in his list of skills and he adds a list of dispositions such as a willingness to be wrong, which, he claims, are also necessary if the skills are to be used. While Ennis writes only of 'critical thinking skills' Lipman (1991) includes 'creative thinking skills' in his list and refers to the combination of 'critical' and 'creative' thinking skills as 'higher order thinking skills' (*ibid.*). Resnick (1987) writes that while we are all able to recognise 'higher order thinking skills' when we see them it is in the nature of such skills that they are difficult to define and assess. This tacit definition from Resnick is provisionally adopted in order to explore the issue further.

This chapter is divided into three sections. The first section looks at the idea of teaching general thinking skills and why this idea has become problematic. The intellectual sources of the challenge to the idea of teaching general thinking skills are traced to two traditions which see thought as embedded in culturally situated 'language-games' (Wittgenstein) or 'speech genres' (Bakhtin/Volosinov). This claim that thought is culturally situated is important to the sociocultural approach which is currently influential in educational research. The second section suggests that the sociocultural paradigm is potentially vulnerable to the philosophical critique of relativism and argues that this problem is closely related to the difficulty of conceptualising general thinking skills within that paradigm. The third section puts forward a theory of rationality as a communicative practice in

order to solve this problem. This definition of rationality is specified as closely as possible in terms of the ground rules of a language-game to offer a sociocultural description of higher order thinking skills.

2.2 The idea of general thinking skills and challenges to it

The 'Central Processing Model' and general thinking skills

In an article on the impact of viewing cognitive development in cultural contexts, Rogoff, Gauvain and Ellis (1991, p 315) draw out and contrast two very different models of cognition. Their characterisation is broad but useful in revealing a fundamental division in underlying assumptions about cognitive development. The first model, which they claim is associated with Piaget and the rationalist tradition in general, they call the 'Central Processing Model'. According to this model each individual has a central processor which contains general skills and propensities. All experiences feed into developing these general skills and propensities and all are equally available to apply to tasks in any context. Rogoff *et al.*, quoting research from the Laboratory of Comparative Human Cognition, call the alternative to the central processing model the 'Specific Learning Model' (*ibid.*). This alternative model which, they claim, has emerged from cross-cultural research, stresses the context-bound nature of cognitive skills. On this model what is learnt in the context of one cultural task can only be assumed to relate to that task. This Specific Learning Model is the corollary of conceiving of thinking skills as being embedded in 'cultural tool systems' (*ibid.*), especially situated language use.

On what Rogoff *et al.* call 'The Central Processing Model' of cognition, the transfer of cognitive skills learnt in one context to another context of application does not need to be explained because it is considered to be the normal case, what needs to be explained is the absence of such transfer. For Piaget, for example, the failure of children who could do a task in one context to be able to do a task with the same

underlying logical structure in a different context was a problem which he felt needed explaining. In fact he gave this problem the name 'décalage' and attempted to explain it in terms of contextual factors (Inhelder and Piaget, 1964; Rogoff, 1990, p 5; Donaldson, 1978). This Central Processing Model naturally suggests the existence of general thinking skills, viewed as context-independent abstract structures of thought underlying context-specific applications. It has been a major influence behind programmes intended to teach such general thinking skills (Nickerson *et al.* 1985, p 36; Papert, 1981; Adey and Shayer, 1993).

According to Perkins and Salomon (1989) there has been a shift away from this model of general thinking skills motivated by a lack of empirical support. They quote a variety of research projects, including work by Thorndike dating back to the early years of this century, recent studies by Hayes and Simon and the considerable research on Papert's LOGO, a programming-based thinking skills project, all of which have failed to find evidence of the automatic transfer implied by the traditional model. They sum up the evidence:

> The case for generalisable, context-independent skills and strategies that can be trained in one context and transferred to other domains has proven to be more a matter of wishful thinking than hard empirical evidence. (1989, p 19)

This analysis is closely supported by Hennessy *et al.* (1993, p 79) who argue from it that the teaching of general thinking skills should give way to the teaching of subject specific thinking skills on the cognitive apprenticeship model. Perkins and Salomon, however, argue that it is a pity that this evidence has been used by some to reject the idea of teaching general thinking skills when the problem lay, they claim, with the overly abstract and overly universal view of thinking skills underlying the different educational programmes. They write that transfer has been shown to occur when certain conditions are met:

> perhaps most importantly, ... when learning takes place in a social context (e.g. reciprocal teaching), whereby justifications, principles, and explanations are socially fostered, generated, and contrasted. (*ibid.* p 22)

This conclusion is supported by the recent evidence of success in achieving transfer of general thinking skills reported by Adey and Shayer (1993). Although Adey and Shayer worked within a Piagetian theoretical framework their intervention programme, which was in the area of science, was based upon discussions of conflicting alternative hypotheses followed by discussions bridging the emerging concepts to other contexts. General thinking skills can be taught, Perkins and Salomon conclude, but to understand how best to teach them we need a new model of what these skills are, a model mediating between the inadequate alternatives of context-free generality and context-bound specificity.

Wittgenstein's influence

Forrester (1992, p 33-5) argues that explanation of thinking skills in terms of internal mental mechanisms on the Central Processing Model is redundant. Since the only evidence we have of the development of cognitive skills and their transfer to different contexts is from social interaction, it is more efficient and effective, he claims, to interpret these skills in terms of social interaction, especially 'participation in dynamic and "on-line" conversational contexts'. A very similar argument is made by Edwards and Potter in advocating a discourse based psychology (1992). These arguments are versions of arguments found in the writings of Wittgenstein. In the Blue and Brown books (1958), describing the mystifications inherent in ordinary language, he writes:

> ...we are strongly inclined to use the metaphor of something being in a peculiar state for saying that something can behave in a particular way. And this way of representation, or this metaphor, is embodied in the expressions "He is capable of ...", "He is able to multiply large numbers in his head" "He can play chess"(*ibid.* p 117-18).

Wittgenstein goes on to note how sure people are that to these kind of abilities:

> there *must* correspond a peculiar state of the person's brain, although on the other hand they know next to nothing about such psycho-physiological correspondences. We regard these phenomena as manifestations of this

> mechanism, and their possibility is the particular construction of the mechanism itself. (*ibid.* p 117-18).

Wittgenstein's point is not that such mechanisms do not exist, although he seems sceptical, but that even if they do they could not explain our thinking and our understanding to us. In place of reductionist explanations, Wittgenstein's method is that of redescriptions to show us the phenomena in a different light. This he calls 'perspicuous representation' (1967, p 122).

The redescriptions that Wittgenstein gives to illuminate the nature of thought are in terms of 'language-games' embedded in 'forms of life'. Understanding how to play a language-game is the same as 'knowing how to go on'. According to Wittgenstein the posited inner darkness of private cognitive abilities is a kind of dream produced by the language and quite unnecessary to seeing clearly the reality that we are and live as we speak, think and 'know how to go on' (1967, p 61).

McPeck (1981; 1990) - the most vocal critic of the thinking skills movement - produces an argument against the possibility of teaching general thinking skills based explicitly on Wittgenstein. He claims that it is meaningless to consider thinking apart from thinking about some subject area. The temptation to do this, and to turn thinking into a separate skill, is an illusion of the way we use language. McPeck writes that:

> Reasoning ability covers all manner of cognitive phenomena' including fishing, writing poems, driving a car and others to the extent that 'the phrase "reasoning ability" does not denote any particular skill, nor indeed any particular *kind* of skill (1990, p 4-5).

He overtly grounds his argument, that critical thinking can best be taught through the traditional subjects, on what he calls 'Wittgenstein's insight about the very intimate connection between thought and language'(1990, p 35).

> ...different subjects employ different language-games, and different language-games have their own peculiar (or unique) rules of predication. ... Thus, there are

> almost as many distinguishable logics, or kinds of reasoning, as there are distinguishable kinds of subject.

It follows from this that there are no useful general skills to be taught, but only the specific skills needed for participating in different language-games.

The sociocultural perspective

In his introduction to a special edition of *Learning and Instruction* on 'Culture and Learning' Roger Saljo (1991, p 179 - 85) argues that the issue of the cultural context of learning has been brought to the fore by historical change, especially the increasing pluralism of modern societies. Culture can no longer be viewed 'as a separate variable and, as it were, be added on to an acultural conception of human activities', he writes, but must be seen as the essential medium of human understanding (*ibid.* p 180). Although the recent cultural turn in educational research shares much common ground with the philosophy of the later Wittgenstein it seems to stem more from Soviet theorists, especially Volosinov (1986), Bakhtin (1981) and Vygotsky (1986). In the special edition of *Learning and Instruction* referred to Wittgenstein was not mentioned while Vygotsky was heavily referenced (Saljo, 1991). Mercer and Fisher, referring to this perspective as 'neo-Vygotskian' (although Mercer later adopted the term 'sociocultural') characterise it as follows:

> The essence of this approach is to treat learning and cognitive development as culturally-based, not just culturally influenced, and as social rather than individualised processes. (1993)

This theoretical perspective questions some of the assumptions traditionally associated with the thinking skills movement. The phrase 'thinking skills' arose from an analogy with bodily skills foregrounding the individual as the unit of analysis and so making it difficult to see 'thinking' as essentially social. To make sense of the idea that thinking is a social rather than an individual phenomenon requires a considerable paradigm shift. Another aspect of the same paradigm shift is to question the idea of thinking as essentially formal. The stress on the

importance of the context of thought becomes, in the 'neo-Vygotskian' (Mercer and Fisher, 1992) or 'sociocultural' (Mercer, 1995a; 1995b; Wertsch, 1991; 1985a; 1985b) research programme, a rejection of the traditional implicit model of thought as being essentially abstract and formal. On the sociocultural model thought is pictured as fully embodied in the often ambiguous business of social interaction.

Wertsch seems to have coined the term 'sociocultural' (1991, p 18-46). Vygotsky preferred the term 'sociohistorical' but is quoted by Wertsch and other proponents of this approach as the main theoretical influence. Writing in the 1930s at the same time as Piaget was developing his enormously influential logico-mathematical structural model of cognitive development, Vygotsky produced a radically different account of development emphasising the crucial role of culture and education. He criticised Piaget for taking an unsituated approach to theory, writing:

> The developmental uniformities established by Piaget apply to a given milieu, under the conditions of Piaget's study. They are not laws of nature, but are historically and socially determined. (1986, p 55)

Vygotsky's programmatic statements repeat the central message that 'all that is internal in the higher mental functions was at one time external' (Vygotsky, 1991, p 36). The claim is that 'higher mental functions' or thinking skills, when looked at as the property of an individual, are internalised versions of social interactions. Even in their internal and individual form they remain essentially social (Wertsch, 1991, p 27). This moves the study of the development of thought into the province of 'historical human psychology' subject 'to all the premises of historical materialism' (Vygotsky, 1986, p 85).

Wertsch (1979) draws the parallel between a Vygotskian account of learning thinking skills as the internalisation of inter-personal processes with Wittgenstein's account of thinking embedded in language-games. Although these

two approaches seem highly compatible, Vygotsky was working within a Marxist framework which differed considerably from Wittgenstein's. One of the most significant differences is Vygotsky's stress on history and the genetic origins of thought. Wittgenstein acknowledges that language-games are embedded in forms of life which change historically but he seems uninterested in the causes of that change. He was concerned only to describe language-games, expressly repudiating any idea that the insights of philosophy should change social practice (1967, p 124). Vygotsky, by contrast, was an engaged educator as well as a psychological theorist. His interest was precisely in changing children by teaching them more effectively and in participating in historical transformation in the new socialist experiment that surrounded him and to which he was committed (Alex Kozulin, introduction to *Thought and Language*, Vygotsky, 1986).

Vygotsky's apparent commitment to a Marxist view of the development of thought in history meant that he had no tendency to that cultural relativism which is associated with followers of Wittgenstein (see Winch, 1970, for example). This is apparent in Vygotsky's views on the essential similarity between the nature of children's thought and that of 'primitive peoples' (Vygotsky, 1986, p 129). However this historical developmental logic is assumed rather than examined in his work (Wertsch, 1985, p 223) and is not the aspect of his thought which has been most influential to contemporary educational researchers (see for example Bruner, 1986; Mercer, 1995b; Rogoff, 1990, p 12) who appear more interested in his description of cognitive development as essentially socially mediated, that is to say as the child's guided internalisation of pre-existing cultural practices.

The sociocultural paradigm, defined broadly to include those who do not use the term but seem to share the key assumptions referred to by Mercer (quoted above), has led to many valuable and insightful studies of learning thinking skills. Collins, Brown and Newman's influential paper on 'Cognitive Apprenticeship' (1986) is subtitled 'teaching the craft of reading, writing and mathematics' and includes

detailed recommendations on ways to teach these 'crafts' basic to school-based education in accordance with the apprenticeship model. Edwards and Mercer's study of classroom interactions describes education as a form of 'cognitive socialisation' (1987, p 161) into a particular form of discourse, 'educated discourse'. Lemke does much the same for school science teaching, describing it as an induction into a way of using language (Lemke, 1990). Rogoff's book *Apprenticeship in Thinking: Cognitive Development in Social Context* (1990) refers to many studies of teaching and learning thinking skills, all of which are studies of skills tied to the context of specific cultural tasks.

Where the Central Processing Model places thinking in the heads of individuals the sociocultural paradigm situates it in cultural practices, social institutions and situated language-games or discourse genres. Whereas for the Central Processing Model the idea of general thinking skills is unproblematic and specific cultural influences on thought need to be explained; for the sociocultural paradigm, and the associated Specific Learning Model drawn out by Rogoff *et al.*, this situation is reversed. Thinking skills embedded in specific cultural practices are considered to be the normal case while the idea of thinking skills in general, that is skills that transcend specific practices and are general to all of them, is problematic and difficult to conceptualise.

2.3 The sociocultural paradigm and the charge of relativism

In situating thought in cultural contexts the sociocultural paradigm inevitably raises what Bruner calls 'the spectre of relativism' (1990, p 30). This apparent area of theoretical weakness is closely linked to the difficulty of conceptualising general thinking skills. If a solution to the problem of relativism can be found within the sociocultural paradigm, that solution may well translate into a solution to the problem of conceptualising general thinking skills. This is why it is worth exploring the charge of relativism and responses to it.

McPeck (1990), quoted above, argues that different language-games define their own criteria for truth validation. The same conclusion must follow even more strongly for moral values. McPeck, being more a follower of Wittgenstein than of Vygotsky, is not perhaps exemplary of the sociocultural position. However he expresses clearly a position, opposed to the possibility of teaching general thinking skills, that is a version of the Specific Learning Model and is related to similar issues central to the sociocultural paradigm. Wittgenstein's notion of a language-game interdependent with a form of life is closely related to Volosinov's (1986) notion of discourse genres developed to explicate Marx's claim that consciousness is embedded in actual social relations. If thought and logic are conceived of as fully situated in language-games or discourse genres, which are in turn embedded in cultural practices, then it would appear to follow that we cannot judge the validity of truth claims or moral claims made within a cultural context from a perspective outside that context. McPeck's claim that each language-game defines its own logic is closely related to the sociocultural claim that thinking skills are culturally embedded. Both appear to be claims that lead to relativist conclusions about truth, rationality and ethics.

The need for reflexivity

Habermas's idea of performative contradiction offers a refutation of relativism based on rules implicit in the performative use of language. This is the idea that:

> there are certain unavoidable assumptions that accompany any argument and the propositional content of the argument cannot contradict these assumptions. (Holub, p 143).

There appears to be such a performative contradiction involved in arguments leading to cultural relativism: their propositional truth claims contradict their implicit performative claims. If they are true, then, as themselves apparently universal claims transcending cultural contexts, they are false.

This argument points to the need for a self-reflective account of thinking skills that can understand the thinking involved in putting forward the account. If, following McPeck, one can isolate the specific logics of language-games then what is the logic that enables one to do that and in what language-game is it embedded? If a writer is able to define the limits of a particular language-game within which a specific logic applies, then he would appear to be, in that very act of definition, transcending those limits and engaging in a higher level discourse with a higher level, encompassing, logic. Understanding the nature of the thinking involved in doing this could lead us to specify the nature of general thinking skills.

This is a real issue for studies in the sociocultural paradigm. In Lemke's study of school science, for example, we have reason described as 'a way of using language' (1990 p121). Lemke shows how approaching the issue of reason from this perspective proves insightful in revealing the genre patterns that apply to it. Reason clearly is, amongst other things, a way of using language. But the challenge raised by Habermas's critique of relativism is: can Lemke account for his own reasoning in the same way? Can his own practice of social science, as exemplified in his book, be adequately described in terms of the 'rhetorical and genre structure patterns' (*ibid.* p 122) he uses to analyse the reasoning of the subjects of his study? Clearly it could be analysed in this way but such an analysis alone would not do full justice to its claims. Lemke's implicit claim, a claim he shares with the scientific rationality he describes, is to transcend any limited cultural context in order to tell the story of school science *as it really is*.

This problem of reflexivity is explicitly raised by Edwards and Potter in proposing their discursive psychology (1991). In a recent article Edwards calls it the 'double irony problem' (Edwards, in press). To expose the rhetorical devices and genre conventions used in constructing 'truth' in a discourse is, Edwards writes, to 'ironise' that discourse. This ironic detachment from truth claims described and deconstructed is itself a rhetorical device used to undermine those truth claims

without explicitly arguing against them. To be consistent, the truth claims of the social science discourse producing this apparently objective account must themselves be treated with a similar ironic detachment and themselves be subjected to the indignity of having their rhetorical structure exposed to view.

The need for context transcendence

The main moral argument against relativism is that it removes any yardstick for the criticism of social practices. This usually has conservative implications because it legitimates, by default, the current practices of any society. In educational terms the critique of the possibility of teaching general thinking skills can lead to the enshrining of existing practices as immutable, particularly traditional subject divisions. This outcome can be seen clearly in the Wittgensteinian arguments of Hirst (1974) and McPeck (1981; 1990), both of whom argue for the specificity of the logics required by the already established academic subjects.

It might seem strange to draw a link between neo-Vygotskian theory and an undue conservativism in education. Many working in the sociocultural paradigm are critical of existing practices and advocate change. The issue here is not what is desired but what the theoretical framework can justify. The use of both apprenticeship and socialisation as models of learning account well for the reproduction of social practices but not necessarily so well for the development of the capacity to criticise and change them. What is needed in addition to an account of social reproduction is a sociocultural account of how reflective and critical thinking which apparently transcends its context can be taught and learnt.

In a review of Rogoff's book *Apprenticeship in Thinking: cognitive development in cultural context* (Rogoff, 1990) Matthews makes a related point:

> To solve well-defined problems arising within particular relatively narrowly defined domains may involve using certain strategies, which can be passed on in a fairly straightforward fashion to 'apprentices'. But there is another thinking, more relevant in many ways to everyday living in a rapidly changing world and

> to participation in a democratic society, which is not so much finding a solution to a well defined problem as trying to understand what the problem itself is (Matthews, 1993).

2.4 A redescription of general thinking skills

Habermas's communicative rationality

Habermas proposes a solution to the philosophical problem of rationality which could be applied to the issue of teaching general thinking skills. Habermas rejects the:

> paradigm of self-consciousness, of the relationship to self of a subject knowing and acting in isolation. (1987 p 310)

which is essentially the paradigm behind what Rogoff *et al.* call the Central Processing Model, in favour of what he calls:

> the paradigm of mutual understanding, that is, of the intersubjective relationship between individuals who are socialised through communication and reciprocally recognise one another (*ibid.*)

This paradigm, which sees the intersubjectivity of participation in language and culture as primary to the secondary constructions of objectivity and subjectivity, links Habermas closely to the sociocultural research paradigm as defined earlier by Mercer. At the same time Habermas offers a theory of rationality in general which overcomes the problem of relativism. He claims that both 'the Scylla of absolutism and the Charybdis of relativism' (1987 p300) result from an often unacknowledged attachment to the paradigm of self-consciousness:

> As long as the basic concepts of the philosophy of consciousness understand knowledge exclusively as knowledge of something in the objective world, rationality is assessed by how the isolated subject orients himself to representational and propositional contents.

This perspective leads to an ahistorical and acultural account of rationality. On the other hand the rejection of the paradigm of consciousness without working out an

adequate alternative paradigm - a charge Habermas levels at Foucault and other post-modernists - leads to the internal contradictions of relativism. But Habermas continues:

> By contrast, as soon as we conceive of knowledge as communicatively mediated, rationality is assessed in terms of the capacity of responsible partners in interaction to orient themselves in relation to validity claims geared to intersubjective recognition (1987 p314).
>
> This communicative rationality recalls older ideas of logos, inasmuch as it brings along with it connotations of a non-coercively unifying, consensus-building force of a discourse in which the participants overcome their at first subjectively biased views in favour of a rationally motivated agreement (1987 p315).

Sociocultural accounts of learning thinking skills have emphasised the importance of bounded cultural contexts but this does not necessarily imply a rejection of the idea that there might be empirically universal features to human culture and human interaction. Rogoff makes this point clearly, writing:

> it is a fallacy to think that sociocultural processes lead to variation and biological processes lead to universals (1990 p 139).

She continues:

> Human problems, and some of the constraints on their solution, are held in common in all human situations (*ibid.*).

Habermas's *Theory of Communicative Action* (1984), is grounded on an attempt to specify the nature and implications of the sociocultural universals involved in the pragmatics of language use (Habermas, 1979). He argues that successful communication depends upon certain minimum conditions being met. These include the implicit raising and accepting of three validity claims: a claim to propositional truth about states of affairs in the world; a claim to appropriateness or normative validity; and a claim to personal truthfulness or sincerity. These validity claims, always implicit in communicative action, are 'speech-act immanent obligations' to offer justifying reasons. If any of them are rejected the speech act fails as a communicative act. But questioning any of the three speech

act immanent validity claims leads, if the orientation towards communication continues without a breakdown, to argumentation in which the questioned validity claim is suspended in hypothetical mode and discussed. This debating of reasons offered in justification of claims is a move to explicit rationality. In this way, Habermas argues, communicative rationality is an emergent property of communicative action which is itself a sociocultural universal.

Habermas's procedural concept of rationality is broader than propositional accounts of rationality. It includes propositional argument about states of affairs in the world with moral argument and aesthetic argument. He is seeking to redeem a holistic view of rationality, a view rooted in concrete speech situations, from the one-sided strategic goal-oriented version of rationality which has become dominant in Western culture (White, 1988, p 10). In discussion of Max Weber's account of distinct rationalities Habermas argues that his communicative rationality is primordial to the more specialised versions of it found in law, science and the arts (1991, p 249). His is an account, he claims, of the relatively simple communicative core to rationality preceding and underlying cultural institutionalisations of different rationalities (Habermas, 1991).

A sociocultural answer to the problem of relativism

Bruner defends cultural psychology against the charge of relativism by firstly pointing out that values are not freely chosen but inhere in cultures, and then arguing that his constructivism is an expression of pluralist values inhering in a democratic culture, which is the most appropriate culture for modern conditions where there is both rapid change and the clash of many different claims to validity (Bruner, 1990, p 24 – p 30). Faith in absolutes is no longer adequate, he writes:

> All one can hope for is a viable pluralism backed by a willingness to negotiate differences in world view.

Where there is a need for co-ordinated action, inhabitants of different cultural perspectives must seek mutual understanding. This requires that the habitual

assumptions of each culture must be bracketed while a new, mutually acceptable, version of reality is worked out. In this process of reaching understanding across different perspectives we have a situated yet transcendent rationality. It is not transcendent in the static, *a priori*, sense of Kant's categories but in the historically situated and fallible sense of constantly going beyond the given context in the search for a broader consensus. This bridging of barriers to create a framework for mutual understanding is always situated historically and socially. It is an aspect of the evolution of cultures and involves the creation of new communities.

A similar argument applies to issue of reflexivity in sociocultural research. The charge of operating double-standards leading to an incoherent relativism is applicable where the truth claims of the subjects studied are bracketed out or 'ironised' (Edwards, in press), and their rationality described only in the objectified form of a set of genre conventions, while the rationality of the researcher remains unexamined and unsituated. On Habermas's model, however, it is not possible to describe claims to rationality without engaging with them and thereby being part of a historically and socially situated dialogue in which, in principle, those studied could also participate (1991, p 130).

Specifying communicative rationality

The sociocultural perspective has been characterised as tending to situate thought in language-games, a term taken from Wittgenstein, or discourse genres, a term first applied in this context by Volosinov (1986, p 20) and Bakhtin (1981). Although embedded in different philosophies these two concepts appear interchangeable. Both have the disadvantage of seeming to imply a contemplative attitude. They suggest a static speech situation defined by traditional practice alone. Bakhtin sees discourse genres as 'typical situations of speech communication' (quoted in Wertsch, 1991, p 61) and mentions examples such as military commands, everyday narration and intimate chats. Fairclough's much more recent definition of genre seems similar:

> I shall use the term 'genre' for a relatively stable set of conventions that is associated with, and partly enacts, a socially ratified type of activity, such as informal chat, buying goods in a shop, a job interview, a television documentary, a poem, or a scientific article. (Fairclough, 1992).

On the model of discourse bounded by genre conventions it is difficult to conceptualise the basis for that critical discourse which seems to transcend its context in order to reflect back on it. What is required is the characterisation in discourse terms of the meta-discourse invoked when genre conventions are challenged, debated and changed.

As we have seen Habermas's account of communicative rationality is precisely an attempt to specify the ground rules of the 'meta-discourse' that breaks out when shared assumptions are challenged. He argues that engagement in argumentation presupposes believing that the outcome will not be determined by coercion but by what he calls 'the unforced force' of the better argument. If this minimum belief was not present then sincere debate would not occur. From this requirement rules characterising an ideal speech situation can be deduced. Habermas accepts that all attempts to specify these rules run into problems but he affirms the principle that some specification of these rules is possible. Provisionally he proposes the formulation of Alexy (Habermas, 1990, p 89) which is as follows:

1. Every subject with the competence to speak and act is allowed to take part in a discourse.
2. a) Everyone is allowed to question any assertion whatsoever.
   b) Everyone is allowed to bring any assertion whatsoever into the discourse.
   c) Everyone is allowed to express his attitudes desires and needs.
3. No speaker may be prevented, by internal or external coercion, from exercising his rights as laid down in 1 and 2.

Habermas is not arguing that these are the facts of argumentation but that they are the necessary ideals of argumentation such that in entering into argumentation one is required to accept these ideals:

> Once participants enter into argumentation, they cannot avoid supposing, in a reciprocal way, that the conditions for an ideal speech situation have been

> sufficiently met. And yet they realise that their discourse is never definitively "purified" of the motives and compulsions that have been filtered out. As little as we can do without the supposition of a purified discourse, we have equally to make do with "unpurified" discourse. (Habermas, 1987 p 322)

Habermas's account of the ideal-speech situation can be and has been criticised. It is possibly in the nature of communicative rationality that its ground rules cannot be fixed in advance because they can always be challenged in an ongoing debate which has no necessary end. Despite this the central insight of Habermas's position that rationality is more a matter of emergent cultural ground rules than of a determinate logic is gaining increasing acceptance. Rorty argues that Habermas is misguided in seeking universal and quasi-transcendental grounds for rationality. But he agrees that rationality must be defined through 'the sort of encounter in which the truth cannot fail to win' (Rorty, 1991, p 39) and that this depends on certain 'virtues' such as 'relying on persuasion rather than force' and 'respect for the opinions of colleagues'. In a recent article Burbules and Rice (1991) argue similarly that:

> ... the success of dialogue across differences ... depends on what we have called "communicative virtues" that help make dialogue possible and help sustain the dialogical relation over time. These virtues include tolerance, patience, respect for differences, a willingness to listen, the inclination to admit that one may be mistaken, the ability to reinterpret or translate ones concerns in a way that makes them comprehensible to others, the self-imposition of restraint in order that others may "have a turn" to speak, and the disposition to express oneself honestly and sincerely.

Communicative rationality and learning to think

Vygotsky saw thinking as a 'function of the brain' (quoted by Wertsch, 1985 p 201). Social interaction was not itself thought but could become transformed into thought if internalised. This social interaction when internalised as thought was described by Vygotsky as 'quasi-social' (Vygotsky, 1991 p 41). Current sociocultural perspectives take this further to argue that participation in social

interactions is not distinct from the internalisation of social interactions and that the old pre-occupation of psychology with the contents of the brains of individuals can be simply side-stepped (Wegerif and Mercer, *in press;* Edwards and Potter, 1992; Forrester, 1992). In much recent philosophy there has been a movement away from the dualism of internal and external in favour of the paradigm of intersubjectivity which places inner thoughts and outer world both within a shared cultural and linguistic space (Habermas, 1987; Rorty, 1980; Gallagher, 1992). The same paradigm shift can be seen in Lave's suggestion that we conceptualise what Vygotsky called 'internalisation' in terms of the 'process of becoming a member of a sustained community of practice' (Lave, 1991, p 65). Lave illustrates this view with ethnographic accounts of how individuals can progress from being peripheral participants in a social practice to becoming increasingly central practitioners able in their turn to guide new novices.

Lave's translation of the Vygotskian idea of internalisation into one of guided induction into a community of practice requires us to identify the cultural practice supporting 'higher order thinking skills'. Communicative rationality seems a prime candidate. This ideal of rationality defined as that speech situation in which good reasons win out over subjective interest or coercion, is central to the arts, to science, the law and government in our society. In principle the community of practice for communicative rationality should be all of us.

2.5 Conclusion

This chapter has developed a model of thinking skills and of learning to think which will inform the research described in the rest of the thesis. Thinking skills have been described in terms of a cultural practice called 'communicative rationality' and learning to think has been described as induction into that practice. However the argument of this chapter has been highly theoretical and has not produced models which can be translated easily into practical guidelines for classroom education. The definition of communicative rationality needs

fleshing out as does the theory of learning to think. The next chapter will look at similar issues to those explored in this chapter but from the very different point of view of empirical research into children's talk in the classroom.

Chapter 3 An empirical study of children learning to think

3.1 Introduction

This chapter reports on an observational study of a discussion-based thinking skills programme in a state primary school. The research described in this chapter complements the more conceptual approach taken in Chapter 2. In Chapter 2 a language-game supporting higher order thinking skills was partially characterised through conceptual arguments. This chapter explores the same theme but through empirical data gathered in a classroom context. It offers a situated account of the language practices supporting both higher order thinking and the teaching of higher order thinking.

The chapter starts with brief sections on background to the study and the methods used in the study before the main analysis of the programme is presented in two parts the first of which describes and interprets the talk of the teacher and the second of which focuses on the talk of the children. After this analysis some of the limitations found with this programme are drawn out and used to point to a possible role for computers.

3.2 Background

The teaching method

The thinking skills programme observed in the study was based on Matthew Lipman's 'Philosophy for Children' system (Lipman, 1985; 1991) as developed for the English primary school context by Murris who called her approach 'Philosophy with Children' (Murris, 1993).

The Lipman method emphasises the importance of creating a 'community of enquiry' in the classroom through whole class discussions facilitated by a teacher.

Lipman has produced a range of written materials to support this method covering the range of philosophical concerns and all age groups from 5 to the last year of high school. These books, written in the form of novels, are used as the focus of class discussions. There have been a number of evaluations of the Lipman method (Coles and Robinson, 1989; Resnick, 1987; Nickerson, 1985; Craft, 1991) all of which are positive in their qualitative findings but less clear in demonstrating a measurable effect across subject areas. The main feature distinguishing Murris' 'Philosophy with Children' method is the use of 'real' picture books to stimulate discussion in place of Lipman's specially written materials. Murris's method has recently been evaluated by the Dyfed Local Education Authority who found that, in an eighteen month trial, its use led to marked improvement in a number of indicators including a measure of general thinking ability (Davies, 1995).

Participants

The study was conducted with the close collaboration of a teacher in a local primary school, Mark Prentice, who has trained in the philosophy for children method both with Lipman and with Murris. Prentice taught two separate groups, one of 9 children aged five to six years, the other of 8 children aged seven to eight years. The group of younger children consisted of 5 boys and 4 girls, the older group consisted of 4 boys and 4 girls. The groups had been selected to be of mixed ability including children with special needs. Prentice believes that this method is of particular benefit to children with learning difficulties (See Prentice, 1989).

The programme

The two groups were given one lesson each week using the 'Philosophy with Children' method and the book *Where the wild things are* by Maurice Sendak (1963, see Appendix A.1). With the younger group the lessons lasted approximately 20 minutes, with the older they lasted approximately 35 minutes.

3.3 Method

Data collection

Five sessions each of both groups of children were video-taped, including the first and last sessions. Transcripts of the talk of the first and the final sessions with each group were made from these videotapes and are given in Appendix A.2 to A.6. Data was also collected through classroom observation and conversations with the teacher and pupils.

Qualitative analysis

The research described in this chapter, and in the first part of the thesis as a whole, was designed to generate a theoretical framework prior to the design of a larger main study in which this theoretical framework could be tested and refined. To fulfil this purpose the study was highly exploratory.

Two equally important initial moments in the qualitative analysis were: 1) gaining an intimate knowledge of the data as a whole and 2) building up an 'interpretive web' through reading relevant theory. Interacting these two strands in the dialogue of a close reading produced significant patterns. These were selected, tested and refined in a process which Parlett (1977) calls 'progressive focusing'. The theoretical assumptions of this study come from Habermas's methodology of 'rational reconstruction' characteristic of 'sciences that systematically reconstruct the intuitive knowledge of competent subjects'. In this case the aim is to reach through the contingent context of the study to discern the rules that underlie and generate 'higher order thinking'.

In an article on the method of teaching philosophy through picture books, Prentice, the teacher in our study, described the discussion as developing in phases. The first two of these were becoming aware of and understanding the scene and the story while the third reflected on this shared context, raising the wider 'philosophical' issues implicit in either the story or the children's comments

(Prentice, 1989). This is an interesting parallel to Habermas's account of the 'explication of meaning' in general. The first stage, the understanding of content, is to make links between the surface structures of the unfamiliar text and the surface structures of familiar texts; paraphrasing, translating and producing metaphors. This level simply applies intuitive knowledge without questioning it. The deeper level of understanding 'attempts to explicate the meaning of a symbolic formation in terms of the rules according to which the author must have brought it forth' (Habermas, 1979, p11). In other words the implicit rules behind the construction of shared meaning are subjected to reflective questioning to make them explicit, converting tacit 'know-how' into conscious 'know-that'. A similar process is often illustrated in the transcripts. Having read some of 'Where the wild things are' the first question asked is 'What is "wild"?', and a word the children thought they understood already is explored in more depth leading to new insight as to the rules behind its use (Appendix A p 19). This describes the aim of this study; converting our tacit knowledge of critical thinking implicit in our capacity to recognise it, into explicit knowledge of its preconditions.

Quantitative analysis

Quantitative measures were used to support the qualitative analysis. Functional categories of teacher talk were induced from the data and applied to code the teacher's talk in the first and last sessions of both the groups studied. Turns at talk (Sacks, Schlegloff and Jefferson, 1974) were used as the main unit of analysis. Where a turn at talk served more then one function, for example a recapitulation in one sentence and a reflective question in another, then these different functions were both counted. This led to the total count of the number of times different functions were served in the teachers talk being greater than the total number of the teacher's turns at talk. Turns at talk were counted to give a rough indication of the extent to which different participants engaged in the programme and how this changed over time. Key words were counted to give a rough indication of changes in the style of talk of the children.

3.4 The teacher's talk

To be able to reproduce the key elements of the thinking skills programme studied in a different form it is important to be able to reconstruct, as far as possible, the teacher's role. After a brief report of the teacher's aims, we examine his practice through a coding analysis and interpret this as situated coaching of the discourse genre lying behind 'higher order thinking'.

The teacher's self understanding

The main sources for the teacher's self understanding of his role were informal discussions with the teacher, his published work (Prentice, 1989) and the teaching manual he was working from. The teacher had very recently been on a training course with Karin Murris and expressed full agreement with her approach. Karin Murris's manual *Teaching Philosophy with Picture Books*(1993) gives general guidelines for facilitating 'philosophical discussion' and specific advice on the best way to use several 'real books' including *Where the Wild Things Are,* which was the book exclusively used in all the sessions recorded. Karin Murris recommends a wide variety of open ended probing questions designed to draw children out, to force them to specify positions and to consider the implications of those positions as well as questions directed at taking an overview of the content of the discussion as a whole.

Murris makes it clear that the teacher's role is to facilitate the specific kind of interaction she calls 'philosophical discussion' in which 'thinking about thinking' occurs through argumentation about open questions to which there is no simple 'correct' answer. She emphasises the importance of making connections with the context of what is already known, of questioning authority in order to independently determine truth and of the overall aim of allowing the children to make personal sense of their experiences.

The teacher's practice

A count of the number of turns taken by the teacher as opposed to the total number of turns gives a crude idea of the degree of active teaching involved (Table 1). As the teacher's turns were, on average, longer than those of the children, a measure of teacher talking time in relation to total talking time would have been higher.

Table 1. Teacher turns in relation to total turns

	First session 5/6 yr. olds	Last session 5/6 yr. olds	First session 7/8 yr. olds	Last session 7/8 yr. olds
Total turns	180	182	326	229
Teacher turns	76 (42%)	72 (39%)	138 (42%)	71 (32%)

Analysis of the teacher's turns in the transcript suggested that the overwhelming majority fitted into three broad categories: control, recapitulation and reflective questions (Table 2). Most turns could be categorised under one function, but when a turn clearly served more functions all were recorded. For example if a turn contained recapitulation and a reflective question in separate clauses, then both functions were recorded. There were many ambiguous cases. The difficulties will be described in more detail as we look at each functional category in turn.

Table 2. Functional categorisation of teacher turns

Teacher talk	First session 5/6 yr. olds	Last session 5/6 yr. olds	First session 7/8 yr. olds	Last session 7/8 yr. olds
Control	32 (42%)	28 (39%)	28 (20%)	16 (22%)
Reinforcement	2 (3%)	2 (3%)	6 (4%)	1 (1%)
Recapitulation	12 (16%)	10(14%)	28 (20%)	12 (17%)
Reflexive Q's	40 (53%)	44 (61%)	87 (63%)	46 (65%)
Other	2 (3%)	2 (3%)	0	2 (3%)

(Totals are greater than 100% because each turn was allowed to have more than one function)

Control

In education the teacher's role is closely bound up with control in setting up and managing learning situations. Bennett and Cass (1988) use the term 'procedural' for the same category in peer group talk, offering the sub-headings: reinforcement, managing, pacing.

This category had no specific grammatical form; it was applied according to interpreted function. It was quite possible for a question form to be used for control. For example:

> Teacher: Can I just say: these books are very special and if you keep pulling them what's going to happen do you think Rob?
> Rob: They'll break.
> (Appendix A, p 7)

All closed questions that served to establish rules of behaviour were categorised as control. In the initial 'setting up' part of each lesson, when the ground rules were either elicited or imposed, the teacher's talk was categorised as control. Further control utterances throughout the session often took the form 'Let's remember our rules'. Explicit direction of activity such as 'Let's all read the book' were also control.

There was one kind of utterance, or clause in an utterance, that was difficult to classify. Sometimes questions were directed to specific pupils by name, or specific pupils were encouraged to speak. This served to select contributors and generally manage the discussion. On the other hand selecting the next speaker, either by name or through body language, is a normal part of conversation (Sacks, Schegloff and Jefferson, 1974). Where the pedagogic intent was considered to be dominant these were classified as control and in other cases not.

Reinforcement

Reinforcement could be described as positive evaluative feedback. There was no overt negative feedback for the content of contributions, although some comments were ignored in an almost overt manner. Bennett and Cass (1988) classified reinforcement under 'procedural' as part of a teacher role. This is a judgement depending on the whole context and the interpretation of the children. While reinforcement can be a tool for control it is also a normal part of peer interaction. Muttering 'right' or 'interesting' is functionally no different from an encouraging smile. The teacher clearly stated his aim was not to evaluate the quality of contributions. He clearly also wanted the discussion to be held in a warm and supportive atmosphere. On the whole this was the end served by the few utterances classified as reinforcement.

Recapitulation

On examination the category of recapitulation, applied to repetitions, elaborations and rephrasings of previous utterances or series of utterances, was found to be closely connected to the category of reflective question. These two could make up a larger category called 'facilitation'. The function of reflective questions was to focus back on some shared context, particularly something just said, and provoke thought about it. Reflexivity, in a conversation, implies recapitulation. Many reflective questions explicitly repeated, or paraphrased, the previous utterance. Recapitulations were only counted when they occurred without a question or as a clearly distinguished part of a turn at talk, a separate 'clause' in Halliday's terminology (Halliday, 1987), for example the following utterance combines a recapitulation with a reflective question:

> So the magic is some sort of trick. What does that mean then? (Appendix A, p 33)

Reflective questions

This was intended to be a functional rather than a grammatical category looking at questions that reflect back on the growing shared context of the story and the discussion so far to draw out the meaning. In practice all questions, other than the control oriented questions already mentioned, were included under this category making it the largest category of teacher talk (see Table 2) within which some differentiation of types of question might be useful. The following types of question were identified:

- Questions serving a similar function to recapitulation in asking the last speaker to repeat or elaborate what had been said. Examples are 'What do you mean by that?' and 'Sorry?'.

- Questions as stimuli to discussion. Usually these begin from a ground of consensus or shared context which is reflected back on in an open way. In the first session with the older children the first half of the discussion begins with the teacher asking: 'What do you think it means, this word 'wild'?' and the second half begins with 'So what do you think it means to be mischievous?'.

- Generalising/specialising questions probing to see the limits of a rule made in the talk. 'Are all animals wild?' is an example of one side of this function, 'When are animals not wild?' is an example of the other. Related to this are challenges pointing out exceptions to, or contradictions in, what has been said.

- Simple 'Why?' or 'Why do you think that?' type questions eliciting justifying reasons for assertions and coaching the rule that reasons must always be available.

Interpretation of teacher's role

Categorising the teacher's speech acts according to their function represents the first stage of analysis. Now the analysis moves on to attempt to interpret these surface regularities.

Teacher as double-agent

The four functional categories of teacher talk can be grouped into two higher level categories representing different roles. 'Control' is a category belonging to a standard teacher role: the teacher as authority. Both 'recapitulation' and 'reflective questions' belong to a different role: the teacher as facilitator. The teacher as facilitator role belongs to a different 'genre' or 'language-game' than the teacher as authority, but the ground rules of this new genre are set up and policed by the teacher as authority. This makes for a duality in the teacher's role which can be well brought out by an incident in the first session with the older children. The children and the teacher are sitting on the floor in a circle. This arrangement is part of the ground rules and was imposed by the teacher. The teacher has just suggested that everyone in the circle say their name. When all the children have finished he says 'thank you very much' and prepares to continue leading the discussion, but he is interrupted by Emma:

Emma: You haven't said your name.

Teacher: Mark. (pause) uhh Mr Prentice, as you know. (Appendix A, p 23)

The embarrassed pause captures perfectly an awkward shuffle between roles. It emerges that – and this is a commonplace of ethnographic studies – for each social role he has a different name. As equal participant in the group he is 'Mark'; as officially sanctioned agent of the education authority he is 'Mr Prentice'.

Normally the move between roles is much smoother. It is an oscillation between commenting and directing as an outsider, and facilitating as an insider. This stitching movement between perspectives seems to be a crucial part of the educational method.

Ground rules

The main purpose of the majority of the teacher's utterances categorised as control was related to establishing and maintaining the ground rules of the programme. At the beginning of each session seating arrangements were imposed by the teacher. Everyone, including the teacher, sat on the floor in an evenly spaced circle. Then the basic rules of the discussion were elicited from the children with questions. These questions had the same form as later reflective questions but were clearly directed to a predefined end. The teacher was looking for certain rules and would state these explicitly if they were not suggested by the children. The teacher's control interventions during the discussion often took the form of 'Remember our rules'. The explicit rules can be summarised as follows:

- all have an equal right to speak
- everything said must be listened to with respect
- speech should be addressed to the group as a whole or to the previous speaker
- everything said should, if possible, continue the topic being discussed.

These rules explicitly delineate a genre of social interaction, or what Wittgenstein called a 'language-game'. They represent a version of the more general rules of what Habermas has called the 'ideal speech situation' (Habermas, 1991, 1979, 1990, White, 1988) discussed in the last chapter. This version is specialised for the classroom context.

In fact the group cannot be fully compared to an 'ideal speech situation' as the teacher was not an equal participant. The 'ideal speech situation' was more like an educational simulation controlled by the teacher as authority. The teacher's role in establishing and enforcing the ground rules can be interpreted as scaffolding the genre represented by the rules of the 'ideal speech situation'. There is an interesting apparent paradox involved in the hierarchic authority of the teacher in

a school setting being used to establish the freedom from authority required for critical thinking.

Question types

As 'control' was the main functional category for the teacher as authority role so 'reflective questions' was the main functional category for the teacher as facilitator. Labelling them 'reflective' might be considered a tautology but is intended to emphasise the way these questions are used to reflect back on previously established context – both the given text and the speech of the children. Although this was intended to be a functional and not a grammatical category, in practice all the questions, apart from the control oriented questions mentioned earlier, were placed in this category. There are however very important distinctions to be made in the role of questions that are obscured by this similarity of form. Within the data one can trace a sometimes quite subtle conflict between different ways of asking questions, each with a different role for questioner and respondent.

The dominant style that emerges confirms the teacher's self understanding of his role as facilitator. The teacher's role is to avoid imposing his own agenda but to enter into the discourse of the children and help them to explore its implications and contradictions from within. Some of the types of questions used have been described above. This questioning style, related to client-centred counselling, is very different from the questioning style normally found in classrooms. Young (1991) quotes research indicating that questions consistently account for 60% of classroom talk, are nearly all asked by teachers and up to 90% of them require only a rote answer. There are clear indications within the tapes and transcripts that this facilitative style of questioning was new for the pupils. One indication is the repeated stress laid by the teacher on the idea that 'there is no right or wrong, ... everyone has got something to say and whatever you say is not wrong'

(Appendix A, p 2). Despite this the children sometimes respond in a manner appropriate to a different language-game. An example follows:

Teacher: How do you know what's good and what's bad? ... Nikki what do you think ? (...) Just give us an example of what you think's bad.

Gordon: Bad? Oh that's easy. (Puts his hand up straining to be called)

Teacher: Who's got an idea about how we might decide in our minds what we think's bad?

Gordon: Smashing windows.

(Appendix A, p 26)

Here Gordon, perhaps responding to the cue 'give us an example', acts as if he has a good answer to a test that the teacher has set. His whole manner and his vocalisation indicate that he is not 'thinking', as would be appropriate to the new language-game the teacher is coaching, but is responding in a trained, almost automatic way, to provide the response he thinks the teacher wants.

At times the teacher also uses a directive style of questioning. A clear example follows:

Teacher: And this writing here look - it's got story and pictures by Maurice Sendak. So who's the illustrator for this one?

Peter: Maurice Sendak.

Teacher: So who's illustrated the pictures?

Gordon: Maurice Se ...

Teacher: Maurice Sendak - that's it.

(Appendix A, p 23)

Here the questions are leading questions eliciting a correct answer from the pupils. This genre of questioning obviously has an educational role and is not being criticised, but a problem might arise when it is not clear which kind of questioning is being used. In the last session with each group the discussion turned to essentially scientific questions about the relations between the movement of the sun, the moon and the earth. This aroused a lot of interest and some fascinating ideas. However in the case of the younger children at least, it led to some ambiguity in the questioning style of the teacher. He referred them back

to recent observations of the sun and moon made in previous lessons and so directed them, through eliciting questions, towards the 'right' conclusion.

This experience recorded in the transcripts could indicate that the development of thinking skills through discussion requires a distinctively philosophical subject matter, where philosophical questions are defined pragmatically as those without clear answers; in other word as the sort of questions which open up debate (Murris, 1993, Lipman, 1991). However 'real' science also progresses through the kind of debate the children were having. The scientific community can be described as a 'community of inquiry' (Elbers, 1995). In learning how to engage in rational truth-seeking debate the children are being prepared for participation in the scientific community as much as some putative community of philosophers. Recent research into effective science teaching stresses the importance of encouraging children to articulate their 'spontaneous' concepts in order to work with and develop them (Harlen, 1992). This would suggest that the discussion method could be useful for subject areas other than 'philosophy', but that, where there is specific content knowledge to be communicated, a two stage method is needed that distinguishes clearly between genuinely open inquiry and questioning directed to fixed conclusions.

If the aim of this method of teaching is induction into a style of interaction or genre then it is important that the key features of the genre are made clear and not confused with other genres. In the case described above where an apparent confusion occurred it occurred because the external forms of the question types were indistinguishable. Interpretation is required to determine whether a question like "How do we know the earth moved?"(Appendix A, p 15) is an open one facilitating a shared enquiry or a more closed one looking for a specific answer already known to the questioner.

Young (1991) provides a logical typology of possible 'questioning genres' which can aid our distinctions.

Table 3. Question types from Young (1991 p102)

QUESTIONER ANSWERER	Questioner already knows answer	Questioner doesn't already know answer
Answerer expected to know	Type 1: Being tested	Type 2: Telling the questioner what she wants to know
Answerer not expected to know	Type 3: Being 'Socratised' or asked to guess or infer	Type 4: Start of shared inquiry

Examples of all of these different questioning genres can be found in the data. Genre 2 is less central to educational purposes, it occurs in classrooms when a teacher needs information about a pupil's learning background or some detail for administrative reasons and in the data only when the teacher asks questions like 'Where is Karl today?' or 'What were we talking about last week?'. Genre 3 is used in establishing the ground rules and, as we have seen, elsewhere when the questioning style seems directed towards specific answers the teacher knows or wants to hear. Genre 4, where neither the questioner nor the answerer can be assumed to know the answer, is clearly the genre aimed at by the teacher as the distinctive feature of this 'philosophy' method.

Cognitive apprenticeship

The teacher's practice as a whole can be understood in terms of the model of 'cognitive apprenticeship' (Collins, Brown and Newman, 1986; Brown, Collins and Duguid, 1989). This model of education applies the style of teaching and learning of traditional craft apprenticeships to the teaching and learning of cognitive skills. Collins *et al.* (1986) argue that 'cognitive apprenticeship' works in producing useful knowledge because it takes account of the situatedness of learning. It involves the stages of 'modelling, coaching and fading' which can be easily understood on the analogy with being taught how to play a game where the coach first models the moves then supports the learner in making the moves then 'fades' to leave the learner to make the moves alone.

The cognitive apprenticeship model is compatible with Wertsch's application of Vygotsky's theory of development (Wertsch, 1979). Wertsch compares Vygotsky's understanding of speech to Wittgenstein's notion of a 'language-game' and argues that learning cognitive skills can be understood as the internalisation of language-games. In a study of pre-school children being taught how to solve a puzzle task by their mothers Wertsch described 'internalisation' as a shift from 'other-regulation' to 'self-regulation'. Wertsch's study has been criticised (Elbers, Maier, Hoekstra and Hoogsteder, 1992) for over-emphasising the role of the adults at the expense of the creative role played by children in learning. Elbers *et al. (ibid.)* argue, on the basis of a similar study to that of Wertsch, that children play an active role throughout in negotiating the shared definition of the task and that the notion of an initial state of 'other regulation' is too narrow and should be replaced by the idea of an initial 'joint regulation'. However their criticism does not so much reject Wertsch's model as call for it to be expanded to take more account of the role that children play in learning. This is an issue that will be returned to in the next section when the significance of the talk of the children is explored.

In the original Lipman method, modelling of the thinking skills being taught is done by characters in novels written by Lipman. It would be interesting to do further studies to see how important this modelling is to subsequent learning. In the method observed a 'real book' was being used to stimulate discussion and the 'modelling' function was replaced by explicit descriptions of good practice by the teacher. This is done by the teacher in didactic mode. As we have described in the section on 'control' the sessions are framed by the didactic mode in which ground rules and guidelines are made clear. This mode occurs at the beginning, at the end, when the teacher usually thanks the children for the quality of their thinking, and at transition points within the talk when the teacher steps back from the discussion to comment on it in an evaluative or directive way. For example, concluding a discussion about the word 'wild' in the middle of the first session with the older children, the teacher says 'That's why we are here today because

it's very interesting to think that there are lots of different points of view because you have to realise that there's no right or wrong answer ...'(Appendix A, p 22).

Coaching a language-game

Through recapitulations and questions the children are being led to treat their own utterances as positions in an argument to be challenged and developed. With the younger children particularly this coaching can be seen clearly in the overt linguistic forms. A simple count of the number of times the younger children prefaced their utterances with the marker 'I think' and with 'I agree/disagree with x' shows at least that some verbal forms for this social positioning were being picked up. In the first session 'think' used in this way occurred five times, four of these times right at the end of the session with Rob repeating the phrase 'I think it's fair' to get attention. Agree/disagree was not used at all. Although this is the first session with the small group of younger children, it is their second session with the method because it follows an experimental whole class session the week before. In that preliminary session the use of 'think', to give a perspective to utterances, and of 'agree/disagree', to both give a perspective and to relate them to other utterance's, was first introduced by the teacher and picked up by the children. In the final session 'think' as a self-reference has spread to most of the group and is used seven times. The agree/disagree couple, which serves a similar function in locating the utterance as the opinion of the speaker, is used fourteen times in the final session (Appendix A.3). At times it is used excessively, and often inappropriately, as if the children are enjoying playing with a new game, perhaps a game which makes them feel more 'grown-up'.

The greater verbal sophistication of the older children makes this crude quantitative analysis of word use less effective. Once the basic rules of a language-game are accepted they no longer need to be referred to explicitly but are present implicitly (Fairclough, 1992). With the older group the coaching hypothesis is confirmed by the reduction in the number of teacher turns as a percentage of total

turns (Table 1). This figure alone is not overwhelming evidence but, comparing the two transcripts, (Appendix A.4 and Appendix A.5) it is clear that the reason for this is the greater confidence the children have in the last session, where they start the discussion without prompting and then question and challenge each other. In the first session the children generate no reflective questions and few challenges are made to what is said, in the last there are seven reflective questions and many challenges that have a similar function.

The teacher's activity can be described as coaching a language-game. This is the language-game that Murris calls 'philosophical discussion' but that could be characterised more generally as 'reasoning through talk'. The questioning mode fundamental to this language-game is that of 'reflective questions' which Young defines through the fact that neither party is expected to know the answer in advance. These kind of questions coach the need to give reasons and prompt a process of reasoning. The ground rules drawn out from the group emphasise the importance of working together cooperatively. The language-game being coached can be defined through the giving and expecting of reasons for claims within a cooperative framework.

Problems with the model of cognitive apprenticeship

Laurillard (1993) has criticised Brown *et al.'s* (1989) argument that the teaching of cognitive skills should adopt a situated approach on the model of craft apprenticeships. She argues that this model does not take sufficient account of the difference between situated 'first order' everyday knowledge and more abstract 'second order' academic knowledge.

> Everyday knowledge is located in our experience of the world. Academic knowledge is located in our experience of our experience of the world. Both are situated, but in logically distinct contexts. (Laurillard, 1993 p26).

Using the example of teaching and learning Newton's laws of motion Laurillard argues that situated experience of concepts such as force is likely to interfere with

understanding the very different way in which these concepts appear in Newton's laws. The problem appears to be that this kind of knowledge is precisely too abstract and general to be taught through experience. Even the strategy Brown *et al.* propose of showing the use of concepts in different contexts is not enough to ensure that the core concept is learnt. To understand such abstract academic knowledge students have to be led through a dialogue in which the teacher persuades them to adopt a 'second-order' way of seeing the world mediated through symbolic representations.

Laurillard affirms that what she calls the 'situated learning' idea can sometimes be useful and illuminating. It is worth noting that her critique of this idea occurs in a book about university education. The rhetorical model of effective teaching and learning which she argues for requires students to engage in reasoning and reflection both in conversation with teachers and in relation to themselves. This appears to presuppose that students have already learnt some conversational and reasoning skills of the kind that the philosophy with children approach claims to teach.

In Chapter 2 it was argued that communicative rationality had a double nature in that it was both a situated cultural practice and the setting for the negotiation of universal truth claims. In so far as the academic ways of experiencing the world which Laurillard writes about are to be rationally constructed and so understood by students this must be through situated communicative rationality. This language-game, it was claimed in Chapter 2, is the bridge between situated learning and the construction of abstract and general models. The next section of this chapter will explore the talk of the children to see if the ground rules for philosophical discussion which they are being taught led them towards abstraction and generalisation.

3.5 The children's talk

So far this chapter has focused on interpreting the teacher's talk. This section will focus on the children's talk and the active role played by the children in constructing meaning within the context of the programme.

In Thought and Language (1986, p 148-149) Vygotsky writes of the process of intellectual development as uniting two movements, an upward movement of children forming spontaneous concepts to make sense of their experience and a downward movement through which pre-defined scientific concepts are mediated by teachers and are appropriated by children. Elbers (1994) draws attention to the duality in Vygotsky's writing between the theme of cultural transmission and that of children creating meaning for themselves in the context of their own lives. This same duality can be found in the data. It is related to the duality in the teacher's role which has already been remarked upon. That duality involved the teacher moving between being an authority outside the group directing and commenting on the style of interaction and being an equal participant inside the group. The teacher was concerned to establish and coach the ground rules of the discussion leaving the content mainly to the children.

Empowerment

The duality in the teacher's role was connected to the apparent paradox of the teacher using his authority as teacher to coach the children in how to question and criticise authority. Criticism of Wertsch's neo-Vygotskian approach, which is similar to the cognitive apprenticeship model suggested here, has argued that emphasis on how the teacher draws the children in to imitate an already existing cultural practice cannot account for the creative transformation of culture (Elbers *et al.*, 1992; Elbers, 1994). However the language-game being coached in the programme observed was remarkable in that it required that assumptions be questioned and challenged and it encouraged the active creation of meaning by all participants.

The transfer of authority from the teacher to the students required by the language-game being used can be seen at one point in the transcript where the teacher slips fully into participant mode and adds information to the debate about stars:

Teacher:	Somebody said to me once that when you look at some stars, because they are so far away, you don't actually see the star but all you see is the light because it takes so long to come to earth.
Emma:	It might not be true though.
Teacher:	It might not be true. (Appendix A, p 38)

Emma is simply stating something implicit in the way the teacher said what he said. The language-game of communicative rationality, of which reasoning through talk in the classroom appears to be specialised variant, requires that 'truth-claims' are suspended in hypothetical mode unless and until they have been discussed and accepted by all (Habermas, 1979). To be in accord with the ground rules he himself has been coaching the teacher cannot simply add information he knows to be true, although, outside of the group, this is often his role as a teacher. Because the necessary assumption of the language-game being coached is that no participant has privileged access to the truth he has to present his knowledge in an indirect way that subverts its authority. Emma, increasingly acting as genre coach herself, simply reminds him of the implicit ground rules.

Ownership

The following example both illustrates the rich personal material sometimes brought into the discussion by children and, in it's content, reflects on the nature and importance of feeling ownership.

The group have read how, in the story, Max's bedroom turns into a forest and it's walls 'become the whole world' and the teacher asks about the meaning of the word 'world'. Peter says that the world is 'a big round ball in space', but the teacher points out that Max's jungle is a different kind of world. Helen has already pointed out that if you stare in a certain way at the curtains you can see lots of

things in them. Here is an edited version of the transcript (Appendix A, p 41-42) of what follows:

Helen:	There's about a thousand worlds all in one person's head, all in one place.
Teacher:	Which is the reality - this planet idea or the world in your head?
Peter:	They are opposite.
Teacher:	You said they're dead opposite - why is that Peter?
Peter:	Because there is a real world and it's not the same as the other world. This world could be bad and the other world could be good.
Teacher:	What do you think Alex?
Alex:	Well one time I invented my own country which I called Alexland 'cos I became my bedroom, a whole country, and I pretend all my toys are alive.
Teacher:	So you created a world?
Alex:	Yes.
Teacher:	Now is that a real world?
Alex:	Well sometimes I feel like it's really real but then when I've found something like a catalogue, which I pretend you couldn't get catalogues and stuff like that, then the world just disappears.
Teacher:	So it disappears when you look at something else?
Alex:	Yeh when I look at something - when I go downstairs it just disappears, because my bedrooms the best place - because my toys are up there.

In this transcript extract Alex describes how he experiences living a paradigm shift when elements from the adult world so undermine the coherence of his private world that it simply disappears.

'The causing of naughtiness'

It was claimed that the teacher is coaching a language-game which underlies the development of higher order thinking skills. To establish this it is necessary to demonstrate the relationship between these three things; the teacher's coaching activity, the language-game and higher order thinking skills. A start has been made above on showing the relation between the teacher's speech acts and the language-game of reasoning through talk. The way in which this works emerges

with greater clarity in the course of showing the second crucial relationship; that between the language-game coached and the thinking skills that emerge.

It is part of the case being argued for here that this process of the emergence of 'higher order thinking' can be found in any section of the transcripts where the language-game of reasoning through talk is being practised. This analysis is based on a consideration of all the data. To illustrate the general case one particularly clear developmental sequence has been chosen. This is a debate in the first session with the seven and eight year olds which was about what Alex, the main originator, called 'the causing of naughtiness'. The full version can be found in Appendix A, (p 27– 29) an edited version follows:

Teacher:	What do you think makes people bad? Do people behave badly sometimes do you think?
All:	Yes.
Teacher:	So what is it that drives people to behave bad?
Alex:	Other people.
Teacher:	Other people?
Alex:	Yeh. They can make you want to do something naughty. They can tell you to do something naughty.
Teacher:	How do these people tell people to be naughty?
Alex:	Yeh, ... making someone ... well Nicholas once drove - drove Adam to do something naughty - sort of spying on me.
Teacher:	So whose fault would that be do you think?
All:	Nicholas.
Teacher:	Is it the fault of the person who tells the person to be naughty?
Peter:	Yeh.
Teacher:	Or is it the fault of the person themselves ?
Peter:	It's the person that tells them to spy.
Teacher:	Because earlier on ... Earlier on Peter you were talking about, though, that it's up to the person themselves to be good or bad, didn't you? So is it up to that person to listen to someone else telling them to be naughty?
Helen:	They should decide themselves.
Alex:	Yeh.
Teacher:	Who should decide themselves?
Emma:	The person ... not the person that's telling the other person to do it ...
Helen:	The person that's going to do it.
Teacher:	Would you all agree with that?

Gordon: Yeh.

Teacher: Would you agree with that or would you disagree with that? Does the fault lie in the person that tells someone to be naughty or does the fault lie with the person that actually carries out the action?

Alex: Both.

Teacher: ... Who's most at fault the person who does it or the person who tells them?

Emma: Both.

Helen: Both.

Teacher: Alex?

Alex: I think its both because the person the person who's being told shouldn't do it - they don't have to.

Teacher: Ahh, so they're thinking as well. They're making a choice in their mind. Yeh, carry on....

Alex: Umm. The person who tells them, they want to know the information but they don't want to get told off - they want the other person to - the person that they ask - so they decide to use them so they won't get told off themselves.

Emma: That's not always true though.

Alex: They use them for a weapon.

Teacher: So that's an interesting idea; who would like to follow on from what Alex says? Why isn't that always true?

Peter: If someone said that to me I'd say 'all right I'll do it' and then run off and not do it - I'd just tell the teacher.

Teacher: Right, so you'd make that choice would you -

Peter: Yeh.

Teacher: That you wouldn't carry out that action. So do we have the choice over this idea of good and bad, do you think? Can we choose in our minds if we want to be good or bad?

Helen: I'd say yes and then go and tell someone else to go in there and disguise as that person and it probably would be a policeman and the it would just ...

Teacher: That's interesting.

Emma: Can I say something?

Teacher: Yeh, but quick 'cos we're going to stop now.

Emma: I saw on a programme that one person died because another person told him to do glue-sniffing and the other person died.

Teacher: O.K. So who was at fault there do you think?

Emma: Both.

Teacher: Right, that's making a connection isn't it. That's making a connection from what we've talked about here to something that's really happened. Right, well, were going to have to stop here because we're going to run out of time and I don't want you to lose your break.

Part of the pattern here is a representation of the Hegelian dialectic, the pattern of progress through conflict and resolution which Hegel claimed as the universal pattern of the development of thought in all its forms (Hegel, 1975, Miller, 1986). First the teacher probes for a starting opinion. His first question, 'What do you think makes people bad?' is too demanding and gets no response so he provides scaffolding by breaking the question into its two component parts. All agree that people are sometimes bad. We have a starting point. Now this shared ground can be examined to discover its nature through the mediational means of the simple reflective question 'Why?' Alex says that other people make you bad. The teacher intervenes with a combined recapitulation and reflective question to draw Alex to elaborate what he means. Alex may well not be sure what he means until pressed to communicate it clearly to the group. With the help of Peter it emerges that he is recalling a story from his own experience, 'Nicholas once drove Adam to do something naughty - sort of spying on me'. This stage is crucial. The learners provide their own material to think with, material from their lives which really interests and concerns them. The teacher doesn't accept this in the form it is given but draws from it a clear expression of the position being taken in the context of the debate. It is not sufficient to say that Nicholas is at fault, it needs to be expressed in more general, 'disembedded', terms. Once we have the position clearly expressed in relatively abstract terms, although still tied to the story context by the idea of 'spying', the teacher challenges this by comparing it to something said earlier in the debate that appears to contradict it.

In Hegelian terms the thesis produces the antethesis because of it's limitations which appear, after the thesis has unfolded it's full nature, as a contradiction with an equally convincing counter thesis. In this case the starting ground 'there is

badness' leads to the attempted explanation 'other people cause badness' but when this thesis is examined it is found to contain its own contradiction because we too must be bad if, prior axiom, we are free to choose and yet do bad things. This explicit contradiction leads to a shift upwards in level of 'consciousness' understood quite simply as the degree of mediation from the starting ground. The 'synthesis' is not at the same logical level as the thesis and its shadow, but requires a jump in level.

The teacher's role here is simply to clarify and reflect without suggesting a solution. Two positions have been clearly expressed by different speakers and the teacher puts this back to the group: 'Does the fault lie with the person that tells someone to be naughty or does the fault lie with the person that actually carries out the action?' Seeing their own thought laid out clearly is enough to lead the children to a shift in level. One person says 'both' there is nodding, other people say it, a consensus has been reached. This thought is a more complex one than either of the two previously opposed alternatives. The first saw A, a responsible subject, acting on B, a passive object of A's action. The second gave all the subjectivity and responsibility to B, relegating A's prompting to morally neutral background. The synthesis has to grasp how A and B are both partly free subjects and partly passive objects; in other words it must see the story from two perspectives at once, the perspective of the person acting and the perspective of the person acted upon.

The importance of narrative

Alex tries to express this picture in as abstract a form as possible ending up with the analogy of trying to use someone else as a weapon. This is an impressive piece of abstract thinking. Others however respond with stories of what they would do if asked to be naughty. Both Peter and Helen would pretend to agree but go to the teacher or other authorities. Helen envisions some sort of subterfuge to outwit the manipulator with disguises and secret policemen. This seems less mature than

Alex's effort. Anyone seeking confirmation of a shift to abstract thinking would be tempted to just edit these voices out (Gilligan, 1982). But these narrative restatements of the central synthesis are concerned with the practical lived reality of the ideas discussed. In these brief stories we see expressed the recognition of the complex reality of subjective freedom as only operating within real contexts of objective constraint. Neither child feels able to simply stand up against manipulators but suggest ruses to outwit them. This is not a descent from the achieved heights of abstraction back to the valleys of context-bound narratives. These narratives provide a real life context for understanding what it might mean to claim that both the manipulator and the person manipulated have some choice and so are to blame for wrong-doing. The relatively abstract structure that emerges from reflecting on an incident in Alex's life supports the spread of understanding from this narrative to further narratives that have a similar structure.

Piaget's understanding of learning to think as the elaboration of formal structures through the stimulus of various forms of 'cognitive conflict', towards a perfect 'embrace' of the entire universe (Piaget, 1950, p 49-50) is highly Hegelian both in form and implicit feeling. Hegel saw reason emerging through less conscious forms of understanding, such as narrative, towards the perfect clarity of self-transparence. We certainly find this story, the Hegelian and Piagetian story of the emergence of abstract forms from more concrete narrative contexts, in the development of thinking observed in this study, but it is found only within a larger context which involves the return to narrative contexts of real life. In other words the development of abstraction is an internal moment of the expansion of narrative understanding (see Taylor, 1985).

Self-awareness

Being able to extricate oneself, however partially, from the continuing stream of experience and reflect back upon it is a necessary precondition for critical

thinking. The separate self able to stand back and reflect is not simply a given of nature, as many philosophers - Descartes for example - seemed to assume, but something constructed out of culture and, more specifically language. Social genres, as we have defined the term, condition subjectivity through the possible speaker positions that they allow (Fairclough, 1992, Foucault, 1970). 'Philosophical discussion' as an educational genre seems to contain elements that condition and create a particular kind of subjectivity.

We can see a kind of subjectivity being constructed in the pattern of question, response, recapitulation. Here is an example from the first session with the older children (Appendix A, p 5) of an exchange which has a typical element:

Teacher:	What other words would you use to describe (mischief)?
Helen:	Bad.
Teacher:	Is it always bad to be mischief?
Helen:	No.
Teacher:	Now you disagree. Why do you disagree?

The generic property of this exchange is in eliciting an 'opinion' and then positioning it in relation to an ongoing dialogue. The teacher's questions often include the word 'think' as in 'what do you think?'. Once an opinion has been elicited it is recapitulated, or questioned in a way which involves an implicit recapitulation. The utterance of the child is represented in the recapitulation as a turn in a discussion. Through this recapitulation the speaker can hear what she said now outside as her 'opinion' and so is distanced from it and able to reflect upon it. If we look again at the short extract above it is clear that almost whatever Helen said would have been interpreted as an opinion in a debate because this is the nature of the genre. Every assertion in the genre of philosophical discussion has an implicit 'I think' placed before it. Nothing said is simply accepted as given: it is the opinion of Helen or Emma, it is 'what they think' and 'I' might think something else.

As Swearingen writes (Swearingen, 1990):

> 'Jane hit the ball', is narrative; 'I think Jane hit the ball' expresses a mental state about an event. The I referred to in the second, simple sentence doesn't exist in some cultures, though it exists for very young children in our culture.... Increasingly evidence supports the hypothesis that the conscious self, ..., and perhaps self-consciousness itself, are activated and cultivated by forms of consciousness transmitted in metalinguistic language

By metalinguistic consciousness he means using language to reflect upon language, which, as we have seen, is the purpose of 'philosophical discussion' as a genre. As well as being a training in 'thinking' this involves a situated construction of the self-conscious subjectivity implied with thinking.

Any genre has different subject roles and so constructs or constrains a particular kind of subjectivity. Any educational genre can be said to construct, or, perhaps, 'coach', a form of subjectivity. Bakhtin includes teachers with agents of political power when describing the 'authoritative' voice, that 'demands that we acknowledge it, that we make it our own; it binds us quite independent of any power it might have to persuade us internally'. This is the voice of literal meanings with 'no play with its borders, no gradual and flexible transitions, no spontaneously creative stylising variants on it' (Bakhtin, 1981 p343). This describes a didactic educational genre in which the only subject positions are the active authority of the teacher contrasted to the passive acquiescence of pupils. Neither form of subjectivity allows for critical reflection. In contrast the educational genre of 'philosophical discussion' forces both the teacher and the children to participate in the active co-construction of meaning. It is the genre associated with the production of what Bakhtin calls 'the internally persuasive word' that:

> is half-ours and half-someone else's. It's creativity and productiveness consist precisely in the fact that such a word awakens new and independent words, that it organises masses of our words from within, and does not remain in an isolated and static condition (*ibid.*)

The kind of subjectivity that goes with this voice has been called 'the dialogical self' (Hermans *et al.*, 1992), described, in opposition to the Cartesian univocal model of the self, as a community of perspectives engaged in dialogue. This is the

kind of subjectivity being constructed in the discourse genre of reasoning through talk.

3.6 Limitations of the programme

This chapter has developed a loose interpretative framework to understand how the Philosophy with Children programme observed worked in achieving its aim of teaching general thinking skills. This framework can be used to see the weaknesses or limitations with the programme.

The problem of access

A simple count of the number of turns taken by each participant in both of the groups during the first session and during the last session (see Appendix A) revealed that some children were failing to participate significantly and had not been drawn in to participation over the seven sessions of the course. In each group there was considerable inequality in the amount of turns taken and the trend revealed by the difference between the final session and the first session was not significantly in the direction of greater equality. We cannot assume from the absence of speech that children were not following the discussion, indeed in all cases body language and eye movements indicate involvement, but nonetheless it seems likely that active practice is important in learning the language-game of 'philosophical discussion' and that the children who do not find it easy to cross the threshold into active participation are being disadvantaged. This apparent weakness in teacher-led group discussions could indicate a useful role for computer-based learning. Computers, probably because of their inability to judge, have a proven capacity for engaging even the most reserved children (Issroff, 1993, Wegerif, 1992).

The need for 'fade out'

'Philosophical discussion' as a genre can be defined as the cooperative search for truth structured by the rules of the 'ideal speech situation'. (This is obviously not an account of actual philosophy but an 'ideal type' in Weber's sense). The educational genre of 'philosophical discussion' explored through this empirical study is not the same as 'philosophical discussion' itself, but is oriented towards coaching it. Unlike the 'ideal speech situation' educational 'philosophy' involves an asymmetry between the teacher and pupil roles (see Table 4). The teacher uses his or her authority to establish a situation in which the pupils can assume some of that authority for themselves.

The ideal expressed by the teacher was of a transfer from teacher-centred discussion, with virtually every other turn being that of the teacher, to pupil-centred discussion with the teacher making only occasional interventions. The transition required is difficult to make once the teacher role as mediator and scaffolder has been established. Despite the teacher's appeals for the children to talk to each other, their discussion with each other was consistently mediated through him. Figures for turns at talk (Table 1) and our analysis of them above, indicate that, while there was a clear move in the desired direction with the older children, it was disappointingly small.

In the last session one girl seemed to have responded to the challenge, talking almost as often as the teacher (51 turns to 71) and assuming some of the scaffolding responsibilities of the teacher role. In response to this, the teacher, like any good coach, felt obliged to intervene to encourage those who were not saying so much.

An important part of the cognitive apprenticeship model through which we analysed this method of teaching thinking skills as the coaching of a particular genre or 'language-game', is what Newman *et al.* call 'fade out' when the skills are practised without support from the coach. In the data there is some evidence of

fade-out in passages of sustained pupil-pupil discussion, but these were periods of short duration and involved less than half of the pupils.

The difficulty of directive teaching

Some ambiguity in the teacher's role was noted when a scientific topic came up for discussion. The children had some fascinating ideas about the movement of the sun and the moon but they were not all ideas represented in the National Curriculum guidelines for science. The professional responsibilities of the teacher forced him to intervene in the discussion to turn it into a directive teaching session. This unsignalled intervention in the role of directive teacher threatened to disrupt the aim of the programme, which was to coach the children in philosophical discussion. This kind of discussion requires reciprocal dialogue roles and pre-supposes that no one knows the answers in advance. From this incident it is apparent that the 'thinking skills' programme observed cannot be easily integrated into the directive teaching of subject area knowledge. This is a serious limitation for busy teachers with a professional obligation to teach the National Curriculum.

The issue of the generalisation of the skills taught

The last point made about the difficulty integrating this type of coaching with directive teaching is also a serious issue in relation to the aim of teaching thinking skills. The evidence reviewed in Chapter 2 indicates that there is no necessary transfer of skills taught in one context to other contexts. One solution to this is to structure contexts so that they are similar and are perceived to be similar. Bray (reported by Craft, 1993) argues that the teaching of core thinking skills requires a whole school policy with a shared vocabulary agreed by all in the school. In this way similar 'problem solving approaches' can be taken in different subject areas with the pupils able to see the similarities and knowing what is expected of them. If higher order thinking skills are translated in to the concept of the practice of 'reasoning through talk' then it follows automatically that this practice will not

transfer to other subject areas unless it is used in the teaching and learning process in those subject areas. The limitation of the programme that this argument suggests is that the reasoning through talk learnt by the children was not integrated in knowledge construction in other areas of the curriculum.

3.7 Summary and conclusions

The research reported in this chapter demonstrated how learning 'higher order thinking skills' was embedded in learning a language-game. The ground rules of this language-game were clarified and it was called 'reasoning through talk'. Some of the ways in which using it led to the intellectual development of learners were demonstrated through the interpretation of transcripts. From these accounts it was argued that learning to think was linked, through language and roles taken in communication, to the development of self-awareness.

The role of the teacher in the programme was interpreted in terms of the model of cognitive apprenticeship. It was shown that the discussions observed were not true communicative rationality as defined in Chapter 2 but a scaffolded educational version constructed and maintained by the teacher.

Four limitations with the programme were brought out:

- **Access**: the research showed a less equal distribution of turns at talk among the children at the end of the programme than at the beginning.
- **'Fade out'**: the teacher dominated the discussions throughout and there was insufficient opportunity for the children to use their new communicative skills on their own.
- **Generalisability**: the programme was separated from the rest of the curriculum. It was not evident that the communicative practice taught could or would be used in other contexts in the school.

- **Directed teaching:** the style of teaching adopted was only capable of facilitating debate amongst the children when there was no predetermined right answer. This meant that it would be difficult to extend the programme to integrate it with areas of the curriculum where pre-specified knowledge had to be taught and learnt.

These four limitations will all be returned to later in this thesis when it will be argued that the use of computers can help to overcome them.

Chapter 4 Collaborative learning, computers and classroom talk

4.1 Introduction

This chapter continues the project of specifying a classroom language-game for higher order thinking skills. If Chapter 2 took a 'top-down' approach, deducing specifications from high level theory and Chapter 3 took a 'bottom-up' approach, inducing specifications from an empirical study, then this chapter takes a 'sideways' approach, deriving specifications from a review of the literature.

In the previous two chapters the role of computers has only been indirectly referred to. This chapter begins with a brief survey of approaches to the use of computers to support the development of improved thinking skills which concludes with arguments for their use as a support for collaborative learning. The next section reviews research on collaborative learning and concludes with a specification of a type of interaction that is effective in promoting collaborative learning. This is related to the idea of 'exploratory talk' put forward in a typology of talk developed by a recent research project on classroom collaborative work at computers. Finally the nature of exploratory talk is clarified.

4.2 Computers and teaching thinking

Surveys of the use of computers to promote thinking skills by both Hughes (1990) and by Underwood and Underwood (1990) draw a sharp distinction between the use of computers as a tutor to teach thinking skills and the use of computers as a tool in order to develop skills indirectly. Crook (1994) , in a similar survey, argues that both these ways of conceptualising the role of the computer in relation to thinking skills are inadequate. He develops a third approach which he refers to as the use of computers as a 'mediational means' to 'resource collaborative

encounters' (*ibid.* p 227). This section will use these three categories to look at the way computers can be and have been used to promote thinking skills.

The computer as tutor

Riding and Powell (1985) report on a study which used a computer program to tutor 4 year old children in 'critical thinking skills' using a series of problems. Over the period of the study the children showed improvements in score on a test of reasoning – Raven's coloured matrices. However the sort of problems the children were given in the tutorial program were rather similar to the problems in the Raven's reasoning test leaving Riding and Powell open, as they acknowledge, to the charge of not teaching general skills but of simply training children to perform on a specific test. Follow up studies referred to by Hughes (1990, p 125) have shown only very limited transfer to thinking in other contexts. This difficulty in producing transferable skills is to be anticipated from the discussion of thinking skills programmes in general in Chapter 2. It is related to the main criticism of the computer as tutor model which is summed up by Papert's complaint that instead of teaching children how to program computers, computers are being used to program children (1980). In relation to the development of thinking skills both Underwood and Underwood (1990) and Solomon (1987) develop the criticism that directed computer teaching does not allow children to be creative learners able to think and make connections for themselves and so is unlikely to support the development of context-transcending skills.

The computer as tool

Much software used in schools does not have a specific curricular purpose but can be used as a multi-functional tool. Word processors, spreadsheets and programming languages are all examples of the computer as a tool. Underwood and Underwood argue that the best way to use computers to promote the development of thinking skills is as a tool:

> ... we suggest that the most useful pieces of educational software are those that also do not provide right or wrong answers so much as provide opportunities for the development and exploration of ideas. The aim of these activities is not an end in itself in most cases, but is to provide general skills which can be used in the solution of other problems. (Underwood and Underwood, 1990 p 29).

One example of this approach to promoting general thinking skills is the use of the computer language LOGO in schools. The value of teaching programming using logic-based languages such as LOGO was passionately advocated by Papert (1980). In his influential book *Mindstorms* he claimed that active engagement with programming could accelerate children's acquisition of formal reasoning. Since then LOGO has been widely used in schools and widely evaluated. Results seem equivocal. Simon (1987) surveys a number of evaluations to conclude that Papert's hopes that using LOGO would lead to the emergence of general problem solving skills were 'pipe dreams' and 'techno-romanticism'. Underwood and Underwood's survey of evaluation results is much more positive. Hughes' (1990) account of the evidence lies somewhere between the two. Hughes sums up his very balanced survey with the following conclusions:

> exposure to LOGO by itself does not usually lead to cognitive gains; that such gains are more likely to be found with structured teaching; and that the Logo environment promotes social interaction amongst peers (*ibid.* p 133)

The computer as mediational means

Crook (1994, p 67) argues that the computer as tutor model and the more constructivist model of computers as support for developing cognitive skills are both based on similar individualist models of learning. He argues instead for a sociocultural model of learning which, as was noted in Chapter 2, stresses the primacy of intersubjectivity and the joint construction of knowledge through communication. Within the sociocultural model, as was argued in Chapter 2, intellectual development is seen as induction into the cultural and communicative practices through which joint knowledge is formed. This leads Crook to

emphasise the use of the computer as a 'mediational means' supporting the communicative processes of teaching and learning. Whereas both the computer as tutor model and the computer as tool model encourage the view of the use of computers as a kind of treatment leading to an individual learning outcome, the sociocultural model argued for by Crook (*ibid.*) and Mercer (1993) encourages investigation of the way interactions involving computers contribute to the larger classroom discourse that leads to the construction of shared knowledge over time.

Teasley and Roschelle (1993) report a study that illustrates a sociocultural view of the role of computers in supporting collaborative learning. Their study concerned pairs of learners using a simulation designed to teach Newtonian physics, called the Envisioning Machine. In it they argue that the essential medium of the learning is the talk between the learners and that the role of the computer lies in supporting that talk and resourcing their collaboration (*ibid.* p 254). The computer screen offers a shared focus, a means to 'disambiguate' language through images on the screen, and a means to resolve conflicts by testing out alternative views. Teasley and Roschelle write:

> We see the 'computer-supported' contribution to collaborative learning as contributing a resource that mediates collaboration. In ordinary circumstances one cannot imagine two 15-year-olds sitting down for 45 minutes to construct a rich shared understanding of velocity and acceleration. But in the context provided by the Envisioning Machine activity, our students were successful in doing just that. (*ibid.* p 254)

This conceptualisation of the educational role of the computer as a mediational means supporting collaborative learning is the view which is most in accord with the sociocultural theoretical framework proposed in Chapter 2 of this thesis. As Teasley and Roschelle argue, it throws the emphasis away from the computer software and on to the processes through which joint knowledge is effectively constructed in collaborative learning.

4.3 Experimental research on collaborative learning with computers

Recently there have been many experimental studies of collaborative learning with computers. In some of these studies computers were used to support collaborative activities but were not themselves the focus of the study. These studies have been surveyed and summarised in Crook (1994), Light (1993), Issroff (1995), and Joiner (1993).

Piaget's idea that learning is stimulated by conflict in the views of participants which leads to 'cognitive restructuring' was taken up and explored in a range of experimental studies by Doise and Mugny (1984) and Perret-Clermont (1980) at Geneva and by others such as Blaye, Light, Joiner and Sheldon (1991), Whitelock *et al.* (1993) and Light, Littleton, Messer and Joiner (1994). These studies on Piagetian conservation tasks or problem-solving tasks, used individual pre- and post-tests separated by a period of social interaction. Not all the studies supported the claim that socio-cognitive conflict was the main mechanism of collaborative learning. Blaye *et al.* report that disagreement in itself is less important than the fact that it stimulates verbalisation. Light *et al.* (1994) conclude from a range of studies of pair work on computer-based problems that the style of interaction is more predictive of post-test gains than initial differences in perspective. They argue that having to use language to make plans explicit, to make decisions and to interpret feedback seems to facilitate problem solving and promote understanding.

A study reported by Kruger (1993) sheds light on the kind of talk most effective for shared knowledge construction. Kruger recorded and coded the talk of pairs working on socio-moral problems. She found that the quality of the outcome was related to the quality of the dialogue, particularly the amount of 'transactive reasoning' described as 'criticisms, explanations, justifications, clarifications and elaborations of ideas'. Kruger argues that it is neither conflict nor cooperation that is important in collaborative learning but a combination of the two in a form of

interaction which encourages critical challenges within a cooperative search for the best solution.

Underwood (1994) supports Kruger's conclusion and illustrates her claim through a detailed presentation of a successful collaboration at a computer-based task between two children in which:

> suggestions are made by each partner, and are challenged. Each partner's ideas are evaluated. Their hypotheses are tested, and the eventual outcome is a totally successful exercise ... (*ibid.* p 19

This kind of collaboration, he writes, exemplifies:

> ... the type of discussion to be fostered if a successful collaboration is to be seen in the computer classroom (*ibid.* p 19)

Teasley (1995) reports on a study that explored the role of talk in peer collaborations. Her results pointed to the value of social talk in pairs as opposed to children simply talking while working alone. She argues that the most important factor in the value of talk in collaboration is the obligation to make sense to ones conversational partner (Grice, 1975). This, she claims, leads partners to maintain conversational coherence which, in the context of problem-solving, takes the form of plans, strategies and explanations. It is not simply the presence of talk that improves the learning but:

> the types of verbalisations that supported reasoning about theories and evidence

Teasley's conclusion seems to agree with the conclusions of Light *et al.* (*ibid.*) and Kruger (*ibid.*). While, as Light (1993) points out, one should be cautious of the generalisability of findings from experimental studies, it is nonetheless interesting and relevant to this thesis that the findings of experimental studies of successful collaborative learning appear to be pointing to the importance of the type of talk referred to in Chapter 3 as 'reasoning through talk'.

4.4 The 'Spoken Language and New Technology' (SLANT) project

The studies referred to in the last section, apart from Underwood's, were in the experimental tradition. The Spoken Language and New Technology (SLANT) project on the other hand was an empirical study of children working in small groups at computers in the naturalistic tradition of classroom observation. Primary and middle school children in 12 schools in south-east England were observed talking and working together at the computer. Many hours of video-recordings of classroom activities were collected, transcribed and analysed (Fisher, 1992; 1993; Mercer, 1994; Scrimshaw, *in press*). One of the outcomes of the SLANT analysis of children's collaborative activity at computers was a typification of three ways of talking. These have since been elaborated by Mercer, as follows:

- **Disputational talk**, which is characterised by disagreement and individualised decision making. There are few attempts to pool resources, or to offer constructive criticism of suggestions. Disputational talk also has some characteristic discourse features : short exchanges consisting of assertions and challenges or counter assertions.
- **Cumulative talk**, in which speakers build positively but uncritically on what the other has said. Partners use talk to construct a 'common knowledge' by accumulation. Cumulative discourse is characterised by repetitions, confirmations and elaborations.
- **Exploratory talk**, in which partners engage critically but constructively with each other's ideas. Statements and suggestions are offered for joint consideration. These may be challenged and counter-challenged, but challenges are justified and alternative hypotheses are offered (cf. Barnes and Todd, 1978). Compared with the other two types, in exploratory talk *knowledge is made more publicly accountable* and *reasoning is more visible in the talk.* (Wegerif and Mercer, *in press*)

(Transcript extracts illustrating these three types of talk are given in Appendix B). 'Disputational', 'cumulative' and 'exploratory' are not meant to be descriptive categories into which all observed speech can be neatly and separately coded. They are nevertheless analytic categories because they typify ways that children

observed in the SLANT project talked together in collaborative activities. It was claimed that this typology offered a useful frame of reference for understanding how talk is used by children to 'think together' in class.

4.5 The nature and significance of exploratory talk

Exploratory talk was put forward by Fisher (1992) and Mercer (1994; 1995a) as possibly the best type of talk for collaborative learning. This type of talk has a long pedigree in educational research – it is essentially the same type of talk as that put forward by Barnes (1976) and Barnes and Todd (1978) as a ideal type of talk for collaborative classroom work. With the emphasis on accepting challenges within cooperation and on the explicit giving of reasons for claims it appears to fit the descriptions of an ideal type of talk for collaboration that emerges from the experimental research described above as well as the ideal type of talk for developing reasoning skills that emerges from the studies of Chapter 2 and Chapter 3. For this reason the nature of exploratory talk will be explored further in this section.

The earliest version of this tripartite typology was published by Fisher (1992), a member of the SLANT research team. She used a coding scheme to describe exploratory talk in a way that distinguished it both from cumulative talk and from disputational talk. In disputational talk, she wrote, initiations are followed by challenges without any progress, in cumulative talk initiations are accepted without challenges, while in exploratory talk 'the initiation may be challenged and counter-challenged, but with hypotheses which are developments of that initiation.' Exploratory talk then combines the cooperation and joint construction of cumulative talk with the possibility of critical challenge found in disputational talk.

The three types of talk are described as conversational sequences empirically encountered. The level of description is that of speech acts or utterances coded for

their function. While a description at this level is perhaps necessary to define a distinct type of talk, it is not sufficient. Another level of analysis is already implicit. The suggestion made by Fisher (1992) and Mercer (1994) that these types of talk have educational importance, and the claim for the particular value of exploratory talk, rest on intuitions about an underlying significance to the talk.

Discussing issues of methodology, Habermas (1979) writes that conversations are always already structured according to pre-theoretical rules applied by the participants to the conversation. To analyse them, he claims, is to convert these pre-theoretical rules into explicit theory through a process of 'rational reconstruction'. The starting point of this process is the intuitive understanding of the underlying rules structuring conversations available to any competent communicator: the sort of intuition we have, for example, when we recognise that some kinds of talk embody thinking in a way that others do not. Rational reconstruction is the process of articulating these intuitions to make them explicit and available for questioning and refinement.

Habermas (1979; 1991) also proposes a framework for the study of the pragmatics of language use which has some interesting similarities to the trinity of types of talk put forward by SLANT team. The distinction Habermas is perhaps most concerned to make is between 'strategic' social actions oriented to success and 'communicative' social actions oriented to mutual understanding. With this distinction he is challenging the utilitarian idea, still prevalent in some areas of social science, that social behaviour can be understood as the result of many calculations by individuals seeking to maximise their own benefit. Habermas wants instead to establish the primacy of communicative action over strategic action. He claims that we can all intuitively recognise the difference between the strategic orientation and the communicative orientation, at least in our own behaviour. This same distinction can, I think, be seen in the difference between disputational and cumulative talk. In disputational talk, characterised, as we have

seen, by repeated challenges with no shared progress, participants are not seeking consensus but individual victory in a conversation interpreted as a competitive game. In cumulative talk, on the other hand, the emphasis is on maintaining mutuality.

The further difference between cumulative talk and exploratory talk is also paralleled by Habermas in the distinction he draws between unreflexive and reflexive communicative action. Unreflexive communicative action is presented by Habermas as the fundamental mode of social action upon which other modes depend. It is oriented towards 'achieving, sustaining and renewing consensus' (Habermas, 1991 p17). This consensus is based on the acceptance of implicit validity claims. In other words there is a background framework of shared expectations and assumptions that is implicitly appealed to and accepted in each successful communicative action. That this is so is seen when one of these validity claims is challenged. When this happens a choice is faced between shifting into strategic action and trying to impose a definition by coercion, or moving into argumentation which is a way of continuing communicative action in the face of differences. Habermas argues that argumentation is communicative action become self-reflective. In argumentation the rationality that is always implicit in communication becomes explicit: particular claims are not accepted but articulated, suspended in hypothetical mode and critically examined with the use of reasoned challenges and reasoned justifications.

As well as its empirical aspect, seen in Fisher's coding analysis, exploratory talk has a conceptual aspect. It has been carved out as an object in the world of interest to us because it carries the idea of that way of talking which best supports collaborative knowledge construction. Applying the label 'exploratory' to children's talk implies more than a linguistic analysis, it also implies some assessment of the purpose being served by the talk in the context of knowledge

construction over time. Talk that parrots the linguistic forms of exploratory talk but goes nowhere is not true exploratory talk.

This discussion suggests an interpretation of the SLANT project's three types of talk in terms of different levels of analysis. Firstly, the linguistic surface of words recorded and transcribed. Secondly the level of utterances coded according to their apparent function in the immediate context. Thirdly, the rules behind the production of these utterances; for example the sequences of speech acts that are allowed and those that are not. And finally, the orientation of the talk: an idea which can be translated as the rule or rules which guide participants in their choice of rules. This scheme enables a distinction to be made between a linguistic exchange of two or three utterances and a longer session of talk. Disputational exchanges can occur within sessions that, overall, can be judged to be exploratory. Conversely individuals acting strategically can employ apparently cumulative or exploratory exchange types in order to try to trick or coerce partners, seen as opponents, in a session of talk which is, overall, disputational.

In the ideal type of 'cumulative talk' there is an implicit rule that conflict of any sort is not allowed. The talk is oriented towards maintaining the solidarity of the group. In 'disputational talk', on the other hand, conflict is the norm and acknowledged sharing of ideas is ruled out. Disputational talk is oriented towards the defence and affirmation of individual identities. 'Exploratory talk' combines features of both the other types, incorporating the conflict found in 'disputational talk' into the orientation towards consensus found in 'cumulative talk' in such a way that the conflict and competition is not between people but between ideas. The key rule for exploratory talk is that every assertion is hypothetical and must be, at least potentially, justifiable to others through the use of reasons. The orientation of exploratory talk is towards rationally motivated agreement.

Assessing the types of talk found in collaborative work has to take all the four levels of analysis suggested into account. Exploratory talk can be defined at the

linguistic level through key words and usages and at the speech act level through the characteristic functions required of utterances: putting forward a hypothesis, justifying a hypothesis and challenging a hypothesis. However these linguistic levels alone are not sufficient. It is also necessary to look at the content of the talk and to follow the construction of shared understanding over time. Only with this temporal perspective is it possible to re-construct the ground rules being followed in the selection of speech acts and the overall orientation behind the selection of ground rules.

4.6 Summary and conclusion

This chapter began by looking at three possible approaches to the use of computers to promote higher order thinking skills. Only the third of these, Crook's advocacy of the use of the computer as a 'mediational means' to support collaborative learning, was considered appropriate to the sociocultural understanding of higher order thinking developed in Chapter 2. Research findings from experimental research on collaborative learning supported by computers were briefly reviewed. These studies were shown to agree that the quality of the interaction was crucial to collaborative learning and to converge on a characterisation of the ideal form of interaction which closely resembled the characterisation of a classroom version of communicative rationality arrived at through research described in earlier chapters of this thesis. The basic lineaments of this ideal type of talk for collaboration were found again in a recent naturalistic study of computer-based collaborative work in classrooms – the SLANT project – in the guise of 'exploratory talk'. The final section of this chapter teased out some of the conceptual underpinnings of the idea of exploratory talk proposed by the SLANT team. It was argued that exploratory talk could not be defined at the level of linguistic features and speech acts alone but also required some awareness of the ground rules being followed and the overall orientation of the talk. This implies that adequately assessing the amount and quality of exploratory talk in

episodes of talk requires an awareness of the construction of shared knowledge over time and so should not be entirely based on atemporal coding schemes of the kind used in many experimental studies (e.g. King, 1989; Azmitia and Montgomery, 1993; Kruger, 1993; Teasley, 1995).

This chapter has not commented on the specific role of the computer in supporting collaborative learning. That topic will be looked at through empirical research in the next chapter.

Chapter 5 Educational software and the quality of children's talk: Analysis of the SLANT data

5.1 Introduction

Chapter 4 looked at collaborative learning using computers through a critical survey of the literature. This chapter focuses in to explore the quality of the talk of groups of children using specific items of software in the classroom context. The aim of the chapter is to explore the role of the computer in the classroom as a support for children's talk. This is done through an analysis of empirical data gathered by the Spoken Language and New Technology Project (SLANT) which was briefly introduced in Chapter 4.

The first part of the chapter describes a quantitative study of exploratory talk in the SLANT data. The nature of the talk occurring around directive software is explored and a model is developed for the kind of educational interaction observed. The second part of the chapter continues to use the quantitative method developed to help focus a more qualitative study of the software factors affecting the production of exploratory talk.

5.2 Background

This study is based entirely on data collected for the SLANT project (described in Mercer, 1994). In the SLANT project, computer-based activities were devised to fit in with the normal curriculum, using, in all but one case, software available in the schools. The methods used included general observation, filming and interviews with the teachers and the children. (Further details of the SLANT project can be found in Fisher, 1992; 1993; Mercer, 1992; 1994; Scrimshaw, *in press*). Analysis is based on video-tapes and transcripts of the interactions of small groups of children aged between 10 and 13 years over 25 sessions each lasting from 30 minutes to one hour. Details of the size and gender composition of the groups, the

number of sessions for each item of software and the length of the transcripts are given in Appendix C.

In total thirteen different software packages were used.

SMILE is a mathematics package containing highly structured problem solving exercises.

Concept Kate, Nature Park, Hazard Rescue and Wizard's Revenge are all educational adventure games with problem solving tasks embedded in a narrative framework and limited options given to the user.

Viking England is a historical simulation in which children role-play Vikings. In the most successful sessions, from the point of view of producing exploratory talk, they were role-playing Vikings raiding the coast of England. In a further session they explored Viking agriculture.

LOGO is a programming language used for teaching mathematical relationships.

Lost Frog is an authoring environment through which pupils can create adventure games according to a formula.

Bubble Dialogue uses a comic strip format and speech bubbles to promote discussion and to support role-play (see O'Neill and McMahon, 1991).

GRASS is essentially a data-base system.

Mystery Island is a simplified word processing system with built in support for pupils writing illustrated adventure stories.

Front Page is a desktop publishing system.

Pendown and Caxton are word-processing systems.

5.3 Methods

The SLANT project produced a large amount of data in the form of transcripts and audiovisual tapes. The task of exploring uniformities in this data relating software features and features of children's talk, especially the production of exploratory

talk, could clearly be made easier by the use of some quantitative measures. On the other hand the understanding of exploratory talk, developed in the previous chapter, as talk that promoted the shared construction of knowledge, means that no coding scheme would be adequate to the task of capturing it. To assess the orientation of participants and the development of knowledge over time there could be no substitute for a proper reading of the transcripts and/or viewing of the tapes.

The preceding chapter proposed that 'exploratory talk' required four levels of analysis. Only the first two levels of the definition of 'exploratory talk' are relevant to the task of isolating linguistic features possibly indicating the presence of 'exploratory talk'. According to the level of definition, the level of speech acts, 'exploratory talk' involved putting forward hypotheses, defending hypotheses with reasons and challenging hypotheses with reasons. In principle a coding scheme could be applied to the transcripts to count the number of times utterances served these functions. The ambiguous and multi-functional nature of many utterances (Draper and Anderson, 1991) and the large quantity of data involved would make applying such a coding scheme very time consuming. Given that a fuller interpretation would be required anyway because the functions named did not adequately define exploratory talk, this expenditure of time and trouble does not seem justified. An instrument based on word counting was devised as a simpler and more convenient alternative .

In English the hypothetical mode essential to exploratory talk is usually served by conditional tenses introduced by a limited set of words: 'if', 'might', 'would', 'could', 'should' and 'may'. Requests for reasons can be put forward in many ways but one common way is through the use of 'why'. A limited number of words are used to link assertions with justifying reasons: 'because', 'as', 'for', 'since', 'if', 'so', 'therefore' (Thomson and Martinet, 1980 p 285). Not all of these words were relevant for the given data. 'Therefore', for example, was not found in

the childrens' active vocabulary. Sampling of the data led to the following short-list of usages being adopted:

- **'why'** used as a request for justification;
- **'because/"cos'**, **'if'** and **'so'** used to link justifications to assertions;
- **'if'**, **'might'**, **'could'**, **'would'**, **'should'** and **'think'** used to put forward a hypothesis.

Note that this is a list of key usages not of key words. A word count alone proved inadequate. The immediate context of the word needed to be taken into account to determine how it was being used. For example, with some software children read significant amounts of text from the screen and this reported speech contained key words but not key usages. It was necessary to look at each context and code it according to one of the three functions given: request for justification, giving of justifying reasons, putting forward a hypothesis. In this way what looks like a word-counting method was really a partial application of a coding scheme. Focusing on key usages made this partial coding much quicker, easier and perhaps less subjective than it would have been otherwise.

One advantage of this method is that where, as in the case of the SLANT data, transcripts are available in electronic form, searching for key words in their immediate contexts is simple, fast and accurate. In this case search functions built in to Microsoft Word were used.

Where there was a flurry of key usages, focusing in to interpret the talk almost always confirmed that exploratory talk was taking place. Exploratory talk not using these key terms is certainly possible but was rarely encountered in the SLANT data. This meant that the instrument provided in practice a good indicator of the presence of exploratory talk and so a rough measure of the quantity of 'exploratory talk'. But it failed to say anything about the content of the exploratory

talk and its educational value. Evidently this simple quantitative method has to be balanced by a qualitative analysis looking in detail at the content of the 'exploratory talk' detected.

Only pupil to pupil talk was analysed using this instrument. Teacher talk, which was found to include a high proportion of key usages, was excluded as were pupil responses to teacher talk. This condition led to a number of transcripts being excluded from quantitative analysis, particularly those with the younger age-group. The set of transcripts available and suitable for analysis is not a complete set of the SLANT transcripts. The children recorded are all aged between 10 years and 13 years. (Details in Appendix C)

5.4 Results of a quantitative analysis

Figure 1 shows the results of the quantitative analysis of the available and usable transcripts of the SLANT data. Following Newman *et al.*, (1989) and Underwood and Underwood (1990) the software is ordered along the X-axis according to the degree of user-freedom it allows. The broad distinction between directive software and open-ended software is relatively straight forward. Directive software constrains users to a limited number of choices and usually has a specific teaching aim within the curriculum. Tutorial teaching programmes are directive in this sense as are educational adventure games. The most open-ended software, generic tools such as word-processors or programming languages such as LOGO, allow the user considerable freedom in defining the paths taken and the curriculum ends pursued. However rank ordering within each group is much harder to establish. While a word-processing package such as 'Pendown' offers a greater degree of user-freedom than simplified word-processing software designed to support only a certain kind of story writing such as 'Mystery Island' it is not so evident that one can compare the degree of freedom offered users by a word-processing package with that potentially offered by a programming language.

The vertical axis shows the occurrence of the key word usages indicative of exploratory talk as a proportion of total word use. Even in the most exploratory talk this proportion would not be large. Continuous exploratory talk with eleven year old children produced around 5% of key usages.

Figure 1. Results of the quantitative analysis of the SLANT data.

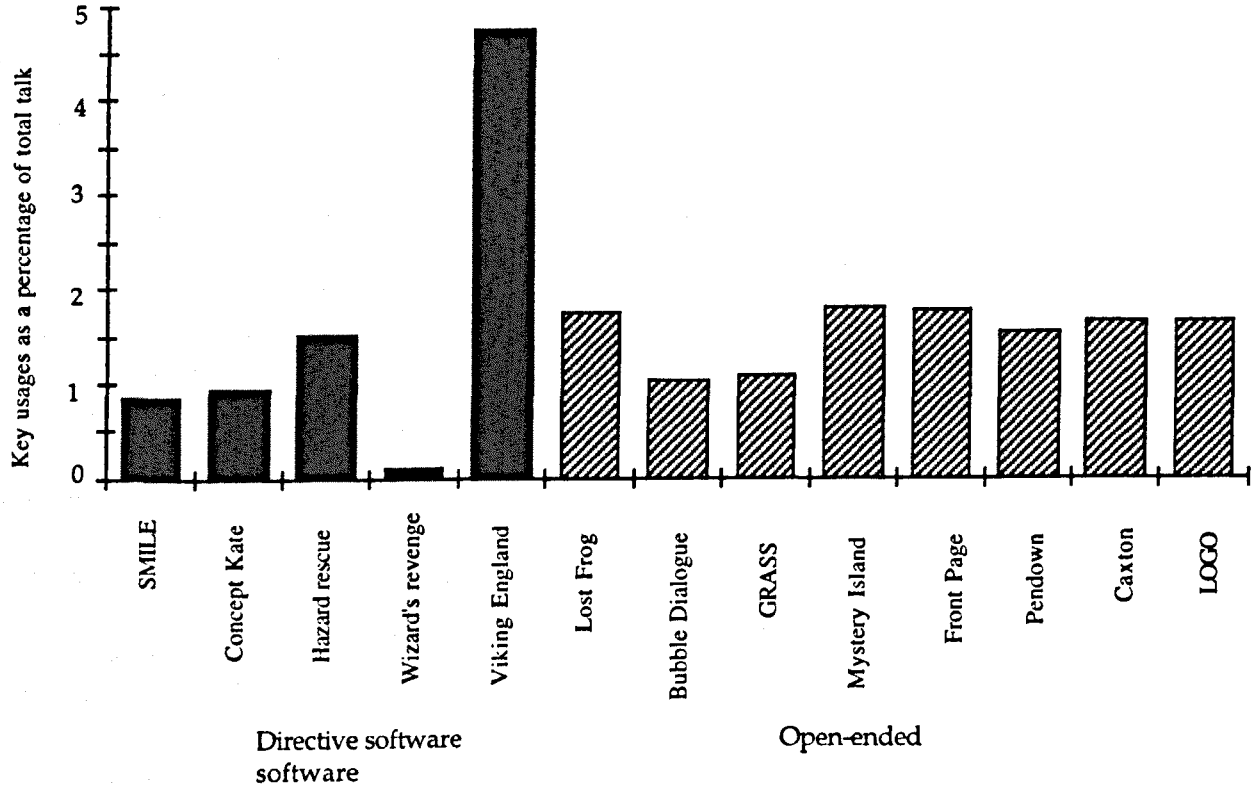
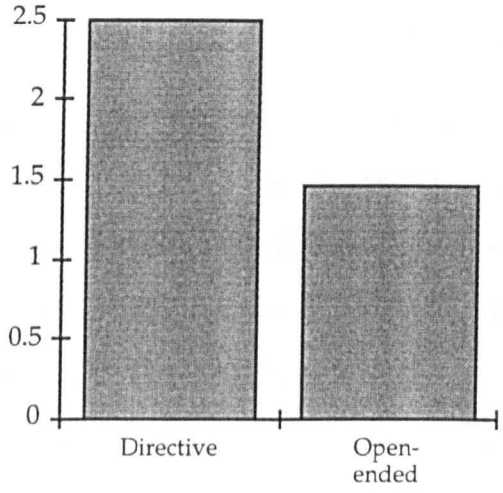
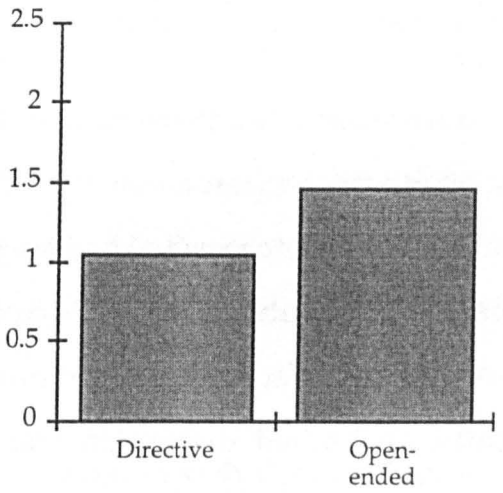


Figure 2: Directive and open-ended software results compared with Viking England



With Viking England

Figure 3: Directive and open-ended software results compared without Viking England



Without Viking England

Discussion of the quantitative results

It is common, and perhaps reasonable, to assume that the tighter the control the software exercises the less active and exploratory the learning of the student. In an article written in the early stages of the SLANT project, Eunice Fisher (1992) suggested that the influence of software on the kind of talk occurring in groups of children working with it could be best analysed by situating the software on an 'open-closed' continuum and that more 'closed' software would be likely to limit the quality of children's talk. Anderson *et al.* (1993) offer support for a similar hypothesis.

The results presented in Figure 1 appear to contradict this widely held view. Software labelled more directive actually supported a higher proportion of key

word usages indicative of exploratory talk than software labelled 'open-ended'. This is confirmed by Figure 2 which contrasts the number of key word usages as a percentage of the total talk produced in collaborative work at directive or 'closed' software with that at more open-ended software. The high degree of exploratory talk occurring around Viking England contributes significantly to this imbalance. In figure 3 the results for Viking England are removed to show that without Viking England the percentage of key usages in the more directive software goes down below that of the more open-ended software.

It turns out that there are pedagogic reasons which might explain the anomolously high result obtained for Viking England. Viking England was used after the teacher concerned had taught oracy skills to her class (see Dawes, 1994), a decision taken after she had seen the first video tapes of children failing to collaborate effectively at computer software. The hypothesis that directive software limited discussion was put forward by Eunice Fisher before the experience with Viking England which shifted attention from the role of the software to the role of the pedagogy. Without the effects of this intervention the hypothesis that more directive software limits discussion would not be seriously challenged by the quantitative analysis. With the addition of the data from the use of Viking England it is challenged and requires qualification. These quantitative results indicate that exploratory talk can take place in groups of users working with more directive software where some have predicted it should not. These results are not meant to be interpreted on their own. The method used is intended to help focus a more holistic interpretation. None the less they do suggest that it might be worth looking in more detail at the distinctive features of the exploratory talk that can be supported by directive software.

The structure of group work with directive software

Exploratory talk at more directive software occurs in the midst of closed computer-pupil interactions where it could not occur in the midst of similarly

closed teacher-pupil interactions. Exploring further the reasons for these results might shed light on the distinct role of the computer in the teaching and learning process.

Eunice Fisher (1992) relates the structure of the interaction with directive software – particularly citing computer-based adventure games – to the Initiation, Response, Feedback (IRF) pattern used by discourse analysts Sinclair and Coulthard (1975) to describe interactions between teachers and pupils in classrooms. Although Sinclair and Coulthard's IRF coding of classroom exchanges has been criticised as an analytic tool it is generally accepted as a description of a structure fundamental to classroom discourse (Edwards and Westgate, 1994 p125, Edwards and Mercer, 1987 p 9; Mehan, 1979; Elbers and Derks, 1995) and is a structure which has been transferred to a great deal of computer aided instruction (Solomon, 1987).

In the following illustration from the transcript of a session with Concept Kate – an adventure game – two boys, Roger and Simon, have found an obstacle to their progress and decide to try to dig their way through. This passage was highlighted for further analysis by the occurrence, in rapid succession, of several 'ifs' to put forward hypotheses, a key usage selected as indicative of exploratory talk:

Simon:	Dig.
Roger:	What can we do? What can we do?
Simon:	To see if the grass is not that again (pointing).
Roger:	What can we do?
Simon:	Just then we can see um um dig to see how if the grass is that hard.
Roger:	No that's too hard remember.
Simon:	Yeah but I know but that path is hard but we are going to be on grass. I ... look if we go on there we need to get on the grass. If we if we walk in there we'll be on the grass, right? So well press dig to see if the ...
Roger:	Dig.
Simon:	And then we'll see if the ground ... now press dig.
Roger:	(presses key) No, it won't work.

If we apply Fisher's coding we find that the exploratory talk which occurs here, involving both a reasoned challenge, ('No that's too hard') and a justification of the initial suggestion, ('but we are going to be on grass. ... If we if we walk in there we'll be on the grass, right?'), occurs between the visual 'initiation' from the screen indicating a blocked path ahead and Roger's eventual 'response'. This illustrates that the apparently limited structure of interface dialogue does not, in itself, prevent the production of exploratory talk.

In this session the two boys took an exploratory attitude towards the problems they encountered but these problems were of too limited a nature to support extended discussions. The same is true for another session in which a pair of children used Hazard Rescue which also produced a quite high proportion of key usages without producing any extended discussion. The vast majority of the key usages recorded around both these adventure-game type programs occurred either singly or in the context of short dialogues consisting of only two or three turns at talk.

In the case of Viking England exploratory talk occurred in the same structural position, within a similarly closed interface dialogue, but the problems posed were much more complex. Figure 1 on page 83 shows that talk between children working at Viking England had a very high percentage of key usages indicative of exploratory talk. Qualitative analysis confirmed extended sessions of exploratory talk between interactions involving the computer.

The computer-user dialogue with Viking England fits Fisher's application of IRF coding well. The computer initiated with questions, the pupils responded by selecting from a small number of options and were then given feedback, sometimes in the form sometimes of an acknowledgement and sometimes in the form of an evaluation. Pupil-pupil discussion occurs consistently within this framework between the initiation and the response.

This possibility is allowed for in Fisher's conversion of Sinclair and Coulthard's IRF coding to the context of computer use. Fisher describes the 'response' as 'any of the following:

(i) a key press

(ii) a key press accompanied by an oral description of what is being done by the operator

(iii) some discussion of what should be done, followed by a key press.' (Ref)

Option (iii) describes the bulk of that exploratory talk which occurs between children working with more directive software.

The following extract from the transcript of a session on Viking England illustrates discussion occurring within an IRF exchange. Jane, Pete and Andy are sitting around a computer screen which is displaying a choice of four sites on the East coast of England. In their role as Vikings, they must select one of these to raid.

Jane:	Let's discuss it. Which one shall we go for?
All:	(inaudible - reading from instructions).
Pete:	1, 2, 3, or 4. Well we've got no other chance of getting more money because..
Andy:	And there's a monastery.
Jane:	And if we take number 2 there's that (...).
Pete:	Yeh but because the huts will be guarded.
All:	Yeh.
Andy:	And that will probably be guarded
Jane:	It's surrounded by trees.
Pete:	Yeh.
Andy:	And there's a rock guarding us there.
Pete:	Yes there's some rocks there. So I think ...I think it should be 1.
Andy:	Because the monastery might be unguarded.
Jane:	Yes 1.
Andy:	1 Yeh.
Pete:	Yeh but what about 2 that ...it might be not guarded. Just because there's .huts there it doesn't mean it's not guarded does it. What do you think?

Jane:	Yes it doesn't mean it's not. It doesn't mean to say it's not guarded does it? It may well be guarded. I think we should go for number 1 because I'm pretty sure it's not guarded
Andy:	Yeh.
Pete:	OK. Yes. Number 1.
	(Pete keys in number 1).
Andy:	(Reads from screen) 'You have chosen to raid area 1'.

It is a little difficult to make out the content of the conversation because there are frequent references to information available on the screen which shows the features of the sites they are discussing. None the less I think it is clear that reasons for and against different sites are being explored cooperatively in a way directed to a rational agreement.

Applying IRF coding to the quoted transcript according to the rules suggested by Fisher (1992), the screen that precedes this discussion is the 'initiation', the whole of the discussion quoted up to and including the point where Pete keys in number 1 is the 'response', and the comment on the screen at the end read by Andy is the 'feedback'. Such a coding though would seriously misrepresent the interaction taking place by subsuming the sustained 'exploratory talk' of the children under the category 'response' as if it was simply an extended form of a key press. A more accurate coding of the educational interaction observed would therefore be: Initiation, *Discussion*, Response, Feedback (IDRF).

The significance of IDRF

Previous approaches to the issue of stimulating and supporting exploratory talk with computers have tended to assume that the user-computer interactions stimulating exploratory talk need to be similar to teacher-pupil interactions serving the same function (see for example Baker, 1992; Dillenbourg and Self, 1992; Cavalli-Sforza *et al.*, 1993; Cumming, 1993). This is a similar assumption to that underlying the 'open-closed' continuum hypothesis. Teacher manuals on facilitating discussion rightly recommend open questions and warn against closed

questions. Analysis of the SLANT data strongly suggests that this transfer of interpretative frameworks from the context of teacher-led education to that of computer-mediated education is misleading and that, given the right pedagogic framework, relatively simple and even 'closed' IRF type exchanges with instructional software can support pupil-pupil 'exploratory talk'.

The reason for this undoubtedly lies in the difference between teachers and computers. Barnes writes:

> ... the very presence of a teacher alters the way in which pupils use language, so that they are more likely to be aiming at 'answers' which will gain approval than using language to reshape knowledge. Only the most skilful teaching can avoid this. (1976, p 78)

Young (1991) points out that teacher questioning styles that involve eliciting answers from children tend to force pupils into the rather demeaning game of guessing what is on the teachers mind. Young proposes, as an alternative, that teacher and pupil should engage together in shared enquiry. This ideal of epistemological equality fostering genuine discussion also seems to lie behind the 'philosophy for children' movement (Lipman, 1991; Murris, 1993). While it might work for the open questions of philosophy, such an ideal would make life very difficult for teachers in most subject areas where there is a particular curriculum to communicate. This difficulty emerged clearly in the analysis of a philosophy for children programme described in Chapter 3.

The suggested IDRF coding for some forms of computer supported discussion combines two very different kinds of interaction. The 'IRF' part refers to the user-computer interaction via keyboard presses or mouse-clicks and the '*D*' to the spoken pupil-pupil discussion. Where, as in the cases quoted above, the discussion between pupils is exploratory, IDRF also combines two very different educational genres. Taking the IRF sequence alone, users are passive and the computer plays the role of a directive teacher. In exploratory discussion mode, on the other hand, users actively consider their options using the information offered

by the computer in the knowledge that the conclusions of the discussion will later be tested out with the computer. In this way the computer acquires the role of a learning environment. IDRF therefore suggests a way of informing subject area knowledge with exploratory talk through which children construct and own their own understandings by combining, in one basic educational exchange structure, directed teaching and active learning.

5.5 Software features influencing the occurrence of exploratory talk

This section offers an interpretation of the data oriented to the aim of developing design principles for software that supports exploratory talk. It begins with two caveats. Firstly, to say that a given piece of software does not support exploratory talk is not necessarily a criticism of it as an educational tool - clearly educational software can serve many valuable ends other than the facilitation of exploratory talk. Secondly, the focus of this paper on software factors is not meant to suggest that the role of the teacher and of pedagogic frameworks is of less significance in the encouragement of exploratory talk. The anomalous quantity of indicators of exploratory talk produced by children working with Viking England, after a specific teaching intervention to coach oracy skills, suggests that pedagogy might be a crucial factor.

Turn-taking

Wherever turn-taking was encountered it seemed to prevent the occurrence of exploratory talk. One reason for this emerges from a comparison of exploratory talk in two different sessions using LOGO. In one session two girls, Linda and Janet, took roles as to who typed and who directed, swapping after each exercise. This session produced no extended exploratory talk and 0.58% of key usages (LOGO 1 in Appendix C). An examination of the occurrence of these key usages found several occasions where exploratory talk might have broken out but was prevented by the procedure of turn-taking adopted. In LOGO numerical instructions are keyed in to get geometric shapes drawn on the screen. An

example follows in which Linda says they should use the command 'FRESH' to clear the screen and offers a reason. Instead of counter-claiming and engaging in exploratory talk Janet asserts her authority as the person whose turn it is to direct:

Linda:	No, we need 'FRESH'
Janet:	No, no, no, Linda
Linda:	We'll need to because it's, otherwise it's gone too far and it won't rub out
Janet:	No, Linda, I know what I'm doing. I don't want it. You were just told to (inaudible) it's me who makes the decisions, you are just typing.

Another session (LOGO 2 in Appendix C) produced three times as many indicators of exploratory talk and, focusing in on these key usages, some modest sequences of exploratory talk could be observed. This session was also with two girls, Rachel and Karen. The significant difference seemed to be that they tackled problems together so that disagreements like the one above produced more discussion. In the following brief illustration they disagree about which command to give to make the shape they want:

Karen:	... forward 25.
Rachel:	No, you see, it won't be big enough
Karen:	It's a bit too big. Do 25, because that's too long.
Rachel:	Let's do 30
Karen:	OK. Forwards 30

In the case of LOGO there was no imperative to turn-taking in the software design but in some cases children adopted this strategy. In one exercise in the SMILE mathematics package turn-taking seemed to be strongly suggested by the software. In this exercise, already commented on by Mercer (1994a), the users took turns to try and find an 'elephant' lost in New York, represented with a grid, by keying in coordinates. Each time the program told them how far away they were from the elephant.

There is something to be learnt from this game about adding and subtracting coordinates, but to learn it users would have to reflect on what they were doing

and try to develop an optimum strategy together. It is probable that this is what the designers had in mind. Instead what was observed was an enthusiastic competitive guessing game. Each boy keyed in coordinates learning from the extent of the other boy's error until one hit the elephant in which case the boy who keyed in would yell 'I won!'. There were some apparently exploratory exchanges but within a disputational orientation which meant that they were isolated and did not lead to shared knowledge construction.

There were many factors contributing to the absence of 'exploratory talk' in this activity using SMILE. Even in the absence of other factors the competitive turn-taking adopted by the pupils would have made 'exploratory talk' unlikely to occur. However software design clearly contributed to the adoption of this style: indeed the combination of discrete moves and a unique goal state seemed to suggest it.

In Bubble Dialogue words and thoughts are put into the speech bubbles and thought bubbles of characters drawn on the screen to create a kind of cartoon story of a dialogue. This exercise was approached in a variety of different ways. In one exercise two girls, Gill and Sally, role-played a school bully and her victim. In the transcripts there was a lot of cumulative talk, described by Eunice Fisher (1993) as talk in which speakers take up a previous initiation without questioning it. The two girls seemed reluctant to challenge each other in a way required for critical discussion. It emerged that the reason for this was that each was taking the main responsibility for the utterances of one character and felt that it would not be right to criticise their partner's suggestions for the other character's speech. Despite the cooperative attitude of these girls very little exploratory talk emerged and so very little explicit reflection on the issues involved in their story.

Across a wide range of software with a wide range of users and contexts turn-taking of all kinds was found to prevent the occurrence of exploratory talk. The

obvious alternative to turn-taking, collective engagement in the construction of each response, seemed to be the only strategy that supported 'exploratory talk'.

Interface complexity

A common difficulty with open-ended software as a support for exploratory talk seemed to be mastering complex interfaces. Typing, in particular, proved very difficult in all sessions that required it. While struggling with the interface does not in itself prevent the discussion of other issues it is likely to shift the task interpretation of users towards the procedural. Where the computer based activity is dominated by the task of typing, the task of typing is likely to become the focus of the activity for the users.

Bubble Dialogue, mentioned earlier, provides a good example of this problem. It was developed specifically to support reflective discussion-based learning (O'Neill & MacMahon, 1991) and claims have been made for it in this regard. It consists of a comic-strip format in which the users have to fill in the thoughts and utterances of the characters on the screen. In the sessions observed a small prologue was used to prepare the context of the dialogue. For four sessions this was about bullying at school and in the fifth it was a girl home late being confronted by her father.

The sessions with Bubble Dialogue had a similar pattern of activity over time. What to input was decided rapidly, by a variety of means, none of them involving extended discussion, then a much longer period was spent typing this input into the computer. This required repeating the sentence several times, saying each word and phrase while typing it and spelling out individual letters. Where discussion did occur it was as likely to be over spellings or how to manipulate the software as about the subject matter of the dialogue being created.

The fact that much more time and effort inevitably went into the interfacing than into the planning of the dialogue almost certainly influenced the children to

interpret the task more in terms of producing a presentable output than in terms of thinking about the issues involved in the dialogues they were creating.

There was a tendency in all the sessions with Bubble Dialogue for ideas put forward to be accepted or rejected without reasons being given so that the dialogue between the pupils did not move into exploratory mode. A common form was 'Shall I put x?' followed by 'Yes' or, sometimes, 'No, put y', without any explicit discussion of reasons. This could be a result of the procedural emphasis on getting something down with less attention being paid to the quality of what was put down.

The software design principle that emerges from this discussion is the well known one that the interface should not get in the way of the intended learning outcome (O'Malley, 1992). If software is intended to foster discussion around the computer, rather than in print or through the computer, then typed input is inappropriate simply because of the difficulty most school children currently find with typing.

Content

Front Page is a kind of desk top publishing package producing a layout like that of a newspaper. In the exercise videotaped using Front Page, the children, two 12 year old girls, had already prepared their material and were arranging it for 'publication'. The results of quantitative analysis shown in figure 1 suggest that this exercise produced some exploratory talk. This proves to be the case. Exploratory talk is not continuous as with Viking England, but breaks out on seven occasions all of which are signalled by little flurries of the key usages.

Mercer (1994a) reports that the teacher found this session 'disappointing'. He suggests that the reason for this was that the children's talk mainly concerned 'procedural' issues such as getting the software to work and how to spell and punctuate the text rather than 'the design of the newspaper as an imaginative project'.

Here is a fairly typical sequence of the exploratory talk occurring in the session with Front Page:

Anne:	... Um .. does that look all right with the thingywod there?
Katie:	I think it needs to be lower down
Anne:	Lower down and moved across and I don't think we need the comma. Full stop if anything. Right, enter. Right. (2 seconds pause) Down
Katie:	Oh right, that's it. 4. F4
Anne:	F4. And it's too far
Katie:	Right enter
Anne:	That's I'll try that. That's right. 'hat's it
Katie:	No it's too far
Anne:	No because if up one that's where it was before

This example fulfils all the criteria set for exploratory talk. Hypotheses are being put forward, challenges given, reasons offered, all in a cooperative and constructive atmosphere. It disappoints only because the content of the talk is limited.

At the beginning of this paper exploratory talk was defined without explicit reference to its content matter. This definition does not give sufficient guidance for educational aims, particularly the aim of encouraging reflection. It might be that the quality of exploratory talk needs to be assessed in terms of the 'open-closed' continuum originally applied to the software. At the most open end would be reflective talk taking into account the broadest possible context linking areas of experience normally considered distinct while at the closed end would be narrowly focused talk of the kind illustrated by Katie and Anne above.

Intrinsic versus extrinsic problems

Viking England has already been described. It shares some structural features with adventure games such as Wizard's Revenge, Concept Kate, Hazard Rescue and Nature Park but use of it produced much more exploratory talk. One significant factor accounting for this disparity may have been a difference in the nature of the problems posed.

The challenges faced in Wizard's Revenge, Nature Park, Concept Kate and Hazard Rescue are local and extrinsic to the larger narrative. In one place in Wizard's Revenge, for example, the users have to solve mathematical sums in order to pass a barrier. In Viking England the puzzles or challenges concern decisions which have to be made in the course of a simulated Viking raid. What to put in the ships, which route to take, where to land. These challenges are intrinsic to the narrative plot. They do not have a discrete right answer independent of the narrative plot as a whole.

Some of the puzzles in one adventure game, Nature Park, are disguised. This is a common element of commercial adventure games. It does not encourage the methodological problem solving approach of discussing all the options. In one session the children using the program found themselves unable to pass a lake and could not find a way round. One of them summed up their frustration by saying: 'But it won't tell us the problem. That's the only problem'. Once the problem is known the solution is usually evident using some item of information local to the program and so is solved instantly without discussion.

In Viking England the problems are clear partly because they are an essential part of the story line and partly because they are clearly articulated by the interface. Solving the problems, or making the decisions that need to be made, requires information from throughout the program and from information sheets provided with it as well as background knowledge on the historical context of the Vikings. The problems offered are the sort of complex problem that benefit from the clear articulation of different points of view.

In view of these points it is necessary to make a distinction between simple problems, all the salient aspects of which can be grasped in a single act of comprehension, and complex problems or issues which benefit from being dealt with in a distributed manner.

This comparison between Viking England and other adventure games/simulations leads to two clear design principles for software supporting exploratory talk. First: problems for discussion should be explicitly articulated. Second: problems for discussion should be of the complex variety which benefit from discussion.

Supports for debate

Most of the exploratory talk observed across the whole range of data involved using material ready to hand. Items were picked up from the context and used to support arguments or think about issues. Turning back to the transcript quoted on page 11 of a session with Viking England we can see that the children refer to the information given pictorially on the screen when discussing which site to raid. The presence of key features on the screen is the visual equivalent to pre-packaging the main arguments to be used in the debate. A similar use of symbols on the screen was found in other cases where exploratory talk occurred. In using Front Page the position of text on the screen was pointed to. In using LOGO the key issue was the position of lines on the screen.

In some cases shared background knowledge was also referred to. In writing an adventure story, children using Mystery Island used the pictures provided to focus their discussion of possible plot continuations, a discussion which drew heavily on their shared cultural knowledge. Using a word processing package called Caxton to produce a brochure advertising their local town, pupils directly applied their personal knowledge in discussing its good and bad features. This last exercise produced an impressive amount of 'exploratory talk' in between bouts of typing.

The design principle that emerges is the need to provide material to argue with, as well as problems to argue about. Even where pupils can be assumed to have this

material available from experience it is advisable to provide props to focus this knowledge and to help structure arguments.

Genre assimilation

The majority of current popular computer games emphasise speed of response at the expense of reflection. These games are likely to have been the main computer-based activity of which older primary and secondary children have experience. In interpreting a new computer based activity pupils will draw upon models available from experience. This means that fast and competitive commercial games are likely to serve as an attractor for the interpretation of whatever computer activities children are offered in schools. If the structure of those activities allows them to be assimilated into the same genre as commercial games then it is very likely that they will be.

An example of this genre assimilation occurs with the SMILE software already referred to. All the utterances of the two boys working at the computer are short. The action is fast and enthusiastic. Occasionally ejaculations such as 'wicked' are uttered or they swear at each other for being stupid. The style is very much that of interaction between children engaged in a competitive turn-taking commercial video-game. It is evident that this is how they see the activity. The design of the software does not impose this interpretation but it has done nothing to prevent it.

When the same users try a further SMILE exercise, a classic problem solving puzzle involving transporting people over a river with only one boat, they find it resists this movement of genre assimilation. Their 'turns' have to be much longer meaning that one of them is relatively idle and restless and they cannot manage without thinking about the strategy. More apparently exploratory challenges and justifications occur in this exercise than in the first exercise, but they still occur within a disputational orientation. The clash between the requirements of the

software task and their expectations leads to frustration and they do not continue the exercise for long.

The first specific design principle that emerges from this study of interaction using SMILE is the need, where the production and support of exploratory talk is the aim, to avoid designing the software in such a way that it can be assimilated into the genre of commercial computer games. The second is the need to provide and reinforce an alternative discourse-based computer activity genre so that the users actually experience 'exploratory talk' as an option when faced with more complex problems which could benefit from it.

This last point, reinforced by the experience with Viking England, indicates a need for the explicit teaching of discursive strategies off the computer. This is not directly a software design principle but, as we have seen it is not possible to completely separate design issues from the cultural environment, including that of the classroom, which influences the way interfaces and tasks are interpreted.

5.6 Summary and conclusions

The research described in this chapter made advances in three areas: methodology for the evaluation of the quality of children's talk, principles for the design of software to support exploratory talk and a theory of the structure of collaborative learning at more directive educational software.

Method

The quantitative method developed to support the analysis of the SLANT data was influenced by two considerations. First of these was the recognition of the inevitably limited role of quantitative measures in discourse analysis. Understanding discourse ultimately rests on our intuitive knowledge as participants in language (Edwards and Mercer, 1987; Habermas, 1979; Potter and Wetherell, 1994). It follows from this that quantitative measures cannot replace qualitative interpretation but can, at best, support it. Once this is realised it is

evidently unnecessary and impractical to attempt to produce elaborate coding schemes which capture all the significant features of spoken exchanges. The second consideration was a desire to develop a methodology which could take advantage of the possibilities offered to discourse analysis by the use of electronic text. The quantitative method suggested for assessing the presence and amount of 'exploratory talk' in texts through the frequency of key word usages was an exploratory move in this direction.

This method proved a useful tool in the holistic process of interpretation. It helped to indicate the presence of 'exploratory talk' at a linguistic level and so highlight issues as a preliminary to further focusing. Where this focusing revealed that the context of the key usages meant that they did not contribute to the development of shared knowledge the reasons for this were always interesting.

Design principles

A number of clear design principles for educational software that supports exploratory talk emerged from the research described in this chapter.

- Turn-taking should be discouraged. One way of doing this is to avoid any series of discrete actions, problems or exercises which users can divide up between them.

- Selecting from alternatives is preferable to typed input with users who are not skilled typists.

- The subject-matter to be discussed is not irrelevant to the aim of producing reflection through talk. The more limited the scope of reference required to discuss or solve a problem, the less value it is likely to be in serving this ends.

- Problems or issues intended to initiate discussion should be intrinsic to the narrative development of the software package as a whole and should not be capable of immediate solution.

- Props should be provided in the form of supporting information or ready-made arguments for and against different positions.

- Software to support 'exploratory talk' should be designed in a way that resists assimilation into existing genres which do not produce reflective talk and which children might have been exposed to. At present this means at least avoiding turn-taking competition and any encouragement to speed of response.

- The issue of the expectations users have about working together at a computer can best be addressed through explicitly teaching cooperative discussion as a style of approaching computer tasks.

Theory

Theoretical frameworks developed for analysing teacher-pupil interaction were found not to apply in unmodified form to the case of computer-pupil interaction. Eunice Fisher's idea that Sinclair and Coulthard's analysis of classroom interactions into 'Initiation - Response - Feedback' (IRF) sequences might be applied to shed light on computer-user interaction was taken up and developed. While IRF seemed a good description of the computer-user interface in all the more directive software, the interaction between groups of users had to be considered independently. Where discussion did occur with groups using this kind of software, it occurred between the 'Initiation' and the 'Response' leading to a suggested 'Initiation - *Discussion* - Response - Feedback' (IDRF) description of the structure of group work around directive software. In much the same way that IRF describes 'the basic teaching exchange' (Edwards and Westgate, 1994) so IDRF describes the basic structure of the educational activity of groups working together at directive software. Where the discussion element is exploratory this exchange structure combines an aspect of directive teaching with an aspect of exploratory learning, integrating the active construction of shared knowledge by

pupils with the teaching and learning of a pre-defined curriculum. In this way the IDRF coding scheme offers more than a description: it suggests a way in which, given appropriate software design and pedagogic contexts, directive software could be used to greater educational benefit.

This is the last chapter in the first part of the thesis dealing with exploratory research. In the next part of the thesis the conclusions from this chapter will be drawn upon in the design and evaluation of an educational programme incorporating the use of computers.

Part II

The main study

Overview

Part II of this thesis applies the findings of Part I to the design, implementation and evaluation of an educational programme incorporating computers (EPIC) intended to coach exploratory talk across the curriculum. First the conclusions of the exploratory investigation of Part I are drawn together into a strategy for incorporating computers into a sociocultural approach to education. The design of a specific implementation of that strategy integrated with the needs of a local school is outlined. Then the design of the evaluation of the EPIC is situated and justified through a discussion of relevant methodological issues. Chapters 8 and 9 both present that evaluation. Chapter 8 focuses on the results of the pre- to post-intervention evaluation of the difference made by the EPIC using discourse analysis and reasoning tests. Chapter 9 focuses on the evaluation of the role of the computers in the programme. Finally, in the concluding chapter, the main themes of the thesis are brought out, the findings of the thesis are summarised, and implications and possible further developments are discussed.

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Chapter 6 Designing an educational programme incorporating computers (EPIC)

6.1 Introduction

The purpose of part 1

Part I of this thesis began with the exploratory question of how best to use computers to support the teaching and learning of general thinking skills, and then re-defined and refined that question towards a possible strategy. First the theory that thinking can be divided into discrete 'thinking skills' was questioned and replaced with the more sociocultural idea of 'thinking' as an aspect of situated ways of communicating both with others and with oneself. The question of how to teach general thinking skills then became translated into the question of how to coach effective communication styles across the curriculum. An empirical study of the strengths and weaknesses of an existing programme to teach thinking to primary children through engaging them in discussion offered guidelines for the possible role of computers in such a programme. A review of research on collaborative learning led to a specification of the type of interaction to be promoted. Guidelines for software design to support this type of interaction – exploratory talk – were drawn from the analysis of the SLANT data on classroom computer. This analysis also led to a theoretical account of the structure of collaborative learning with computers which suggested how computers could be incorporated into the teaching and learning process, so as to integrate reasoning through talk into the learning of curriculum knowledge. The conclusions of the chapters of part I all point towards a way of using computers in education that is effective in teaching thinking through supporting and encouraging language practices.

The structure of this chapter

This chapter is in two main sections. The first and shorter part develops a general educational strategy for the use of more directive software in education. This returns to the theoretical arguments of Chapter 2 to complete them with an account of the role of computers within a sociocultural theory of education. The findings of the empirical studies in the first part of the thesis are then brought together to specify how more directive software could be used to support the coaching of exploratory talk. The major section of the chapter describes the design of an educational programme incorporating computers (EPIC) intended to exemplify the approach argued for. This implementation was designed working closely with a class teacher in a local school. Two items of software were designed to support exploratory talk in a manner integrated with the planned curriculum for a class of year 5 (9 and 10 year old) pupils. These were intended to be used with a series of off-computer lessons designed to coach exploratory talk.

6.2 A general strategy for the use of computers in education

This thesis has adopted and argued for a sociocultural perspective on education which sees learning as a social achievement in which newcomers are inducted into pre-existing practices, particularly ways of using language (Wegerif and Mercer, in press; Mercer, 1995). This perspective emphasises the role of teachers in drawing children into cultural practices but also stresses the active role of learners in appropriating new practices and making them their own.

The sociocultural paradigm owes much to the work of Vygotsky. Vygotsky described intellectual development as involving the meeting of two movements. One he called the upwards movement through which children formed their own 'spontaneous concepts' about the world, and the other was a downwards movement through which pre-existing 'scientific concepts' were actively taught to children (Vygotsky, 1986). Education is a negotiated process occurring in what

Vygotsky, (1986) called the 'zone of proximal development'(zoped) which is the threshold where the upward movement meets the downward movement and learners are carried beyond themselves into the pre-existing culture through the activity of the teacher. The activity of teachers in supporting children in achieving more than they can do unaided is now widely referred to as scaffolding (Wood, 1988), a term which complements Vygotsky's idea of the zoped (Mercer, 1995 b).

Chapter 2 presented arguments to the effect that the role played by 'scientific concepts' in Vygotsky's theory of intellectual development should be replaced by more contemporary accounts of rationality as 'communicative rationality' – a cultural practice defined through the use of reasons and through ground rules conducive to free and open debate between ideas. Applying this translation back to Vygotsky's model leads to the theory that the central pillar of intellectual development is induction into the widespread cultural practice of communicative rationality. Chapters 3 and 4 applied the idea of 'communicative rationality' to the classroom context and located it in the educational concept of 'exploratory talk' as a type of pupil-pupil interaction based on the shared construction of knowledge through the cooperative use of explicit reasoning.

One educational implication of this theory is that pupils should be enabled and encouraged to practise exploratory talk in the classroom. This is not a new idea. Barnes' early advocacy of the educational importance of talk of an 'exploratory' kind (Barnes, 1976; Barnes and Todd, 1978) found official endorsement in British education through the National Oracy Project (Open University, 1991; Norman, 1992) and eventually in the orders for the National Curriculum (DFE, 1995). None the less, recent studies of British primary classrooms indicate that children still have very little opportunity to engage in open and questioning enquiry through talk (Bennett and Dunne, 1990; Edwards and Westgate, 1994). In Chapter 5 it was argued that one reason for this failure to encourage exploratory talk could be the difficulty teachers face in combining free and open discussions with their

professional responsibility to teach a set curriculum (Edwards and Mercer, 1987). In Chapter 3 an empirical study demonstrated that coaching exploratory talk was a difficult role for teachers because it required equal relationships (symmetrical dialogue roles) whereas the teacher-pupil relationship was inevitably unequal or asymmetrical. This problem was shown to be particularly acute in the teaching of pre-specified curriculum knowledge where there is a 'right answer' which the teacher knows in advance.

The role for the use of new technology in education that this argument points to is as a support for exploratory talk between peers. This is similar to Crook's argument (Crook, 1994) for the use of computers in education to 'resource collaborative encounters'. Crook points out that there are many ways in which teachers can devise educational activities in which computers are used as a support for educationally desirable peer communication. Underwood and Underwood (1990) argue for the value of collaborations using generic multi-functional software such as word-processing packages or data-bases. Scardamalia (1989), McConnell (1994) and Wegerif (1995) argue for the potential of computer mediated communication as a support for communicative rationality and construction of educational communities of enquiry.

This thesis focuses on just one way in which computers can be used effectively in the zone of proximal development. The possibility of this role for computers emerged in the analysis of children's interactions working in groups at directive software that was reported in chapter 5. This analysis suggested that, with the right pedagogic context and the right software design, computers could be used to support exploratory talk between peers and, at the same time, direct that talk towards curricular ends. This combination was summed up in the exchange structure IDRF: Initiation, Discussion, Response, Feedback. Vygotsky's two movements, the one upwards from the developing child and the other downwards from the culture, are united in the IDRF combination of peer learning

with directive teaching. Through exploratory talk the children construct knowledge and ways of using language together, while at the same time, their talk is contained within a teaching exchange through which the computer can direct it towards pre-specified curricular ends. This approach could be valuable in both overcoming the difficulty of integrating exploratory talk with normal curriculum teaching and in encouraging active learning within specific curriculum subject areas.

6.3 Design of the main study

Background

Software design and the idea of an EPIC

Chapter 5 produced guidelines for the design of educational software which could support exploratory talk. However one of the findings of this analysis was that the quality of children's talk when they are working together at the computer depends upon the context in which the computers are being used. This finding is congruent with a consensus emerging from evaluations of the educational impact of computer software (Crook, 1991; Underwood, 1990). If the impact of educational software is dependent on the context in which it is used it follows that software should either be designed for a specific educational context, or that the educational context should be designed for the use of a specific piece of software or that the educational context and the software should be designed together in a single package. This third option, integrating the design of the educational context and the design of educational software, is the one adopted for the main study. It will be referred to as an Educational Programme Incorporating Computers (EPIC). The main study is in the form of the implementation and evaluation of an EPIC.

Teaching and learning exploratory talk across the curriculum

The studies reported in Part I of the thesis concluded that the teaching and learning of thinking could best be served by drawing children into the communicative practice of exploratory talk. Surveys of thinking skills programmes referred to in Chapter 2 tend to the conclusion that, to be most effective, the teaching of thinking skills had to be integrated across the curriculum (e.g. Blagg, 1991; Craft, 1993). To be coached effectively, exploratory talk should similarly be integrated with subject teaching and learning in as many contexts as possible. Chapter 5 suggested a way in which specially designed software could be used to serve the educational function of integrating exploratory talk into knowledge construction within subject areas. These points taken together suggest that the EPIC should be designed to coach exploratory talk across the curriculum using computer-based work to serve the function of integrating generic exploratory talk into specific subject areas.

The research partnership method

It is important that the EPIC is carefully contextualised. For this reason the research partnership model proposed by Mercer (1995) was adopted for the development of the EPIC. This model implies the following:

- That the researcher and teacher work closely together in developing and implementing teaching strategies.
- That the researcher and teacher negotiate research aims which are of mutual value.
- That the researcher and teacher work closely together in assessing children's learning and talk.

In contra-distinction to most quasi-experimental educational research, which only involves the cooperation of a teacher once the intervention programme or research

design has been established, this methodology means that the researcher must first contact a teacher and establish a working relationship, and then develop and implement the programme together with the teacher as a research partner.

Working closely with a classroom teacher in the design, implementation and evaluation of the EPIC offers the following advantages:

- That the normal relationships of the classroom are maintained and the research is experienced by the children as a continuation of classroom life rather than as a break with it.
- That the teacher's local knowledge and practical expertise provides a bridge linking educational theory and the design of appropriate classroom practice.
- That the teacher's knowledge of the social context of learning in the classroom can help inform the interpretation of children's behaviour and talk.

The teacher who collaborated in the development of the EPIC was Lyn Dawes of Watling Way Middle School in Milton Keynes. Mrs Dawes had been part of the SLANT project described in chapter 5 and has published articles in professional journals on this research and on methods for teaching oracy skills (Dawes, 1992; 1993; 1994; 1995; Dawes, Fisher and Mercer, 1992).

The EPIC was designed for a year 5 (9 and 10 year old) mixed ability class.

The curriculum areas

For the maximum integration of exploratory talk into the curriculum the ideal solution would be different items of software designed to support exploratory talk in all academic curriculum subject areas. Realising this ideal would, however, have over-reached the time and resources available for the study. As a compromise, two subject areas often considered very different in content – science and citizenship – were chosen to illustrate the approach.

The claim from the argument in Chapter 2 of the thesis and from the educational theory presented earlier in this chapter is that the specific 'rationalities' of different subject areas are versions of a more fundamental rationality in general which, from Habermas, was called communicative rationality. In the next two sections a brief surveys of relevant research will be used to justify this claim in relation to the two subject areas chosen. In so doing they will also outline ways in which exploratory talk should be directed to support teaching aims in these two areas. In principle, according to the perspective put forward in Chapter 2, a similar case could be mounted for any academic subject area.

A language-based approach to citizenship education and moral development

Education for 'citizenship' and 'moral education' are closely linked and overlapping notions (Rowe, 1992). Theory in the field of moral education has been greatly influenced by Kohlberg's theory of moral development (Kohlberg, 1976). Kohlberg argues that there are stages in moral development which occur in a fixed sequence. Others, such as Eisenberg (Eisenberg, Lennon, and Karllson, 1983) have produced variations on Kohlberg's stage model but without challenging the core theory. This core theory is summarised by Eisenberg *et al.* as follows:

> According to a cognitive-developmental perspective as children mature they develop a greater capacity for abstract thinking and for role-taking (i.e. understanding another's cognitive, affective or perceptual perspective). These advances in cognitive capacities are believed to result in qualitative changes in children's reasoning about moral issues, including the ability to understand both abstract moral principles relating to justice and the perspectives of others and of society. (*ibid.* p 846)

According to Kohlberg the three main stages in moral development are as follows:

1) Preconventional. Right and wrong interpreted in terms of physical or hedonistic consequences for self.

2) Conventional. Morality based on conformity and loyalty to social norms.

3) Postconventional. An effort is made to base morality on universal ethical principles.

Habermas (Habermas, 1979; Habermas, 1990) accepts the empirical evidence in support of Kohlberg's claim that moral development occurs in a sequence of stages but argues that the conceptual underpinning of the theory is weak. Instead of an account of cognitive maturation through, what Kohlberg calls different 'social perspectives' Habermas argues that the nature of the stages is better explicated through a model based on stages in the acquisition of communicative competence. Habermas's re-conceptualisation of Kohlburg is based on the development of reciprocity through engagement in dialogue with others coupled with natural stages in the reflexive use of language. According to Habermas, Kohlberg's first 'preconventional' level of morality is grounded on immediate behavioural expectations, the next 'conventional' level is based on the guiding 'norms' which emerge as a result of the first stage of linguistically mediated reflection and the final or 'post-conventional' stage is grounded on principles which emerge from reflection on norms or what Habermas calls the 'norming of norms'.

Habermas's re-conceptualisation of Kohlberg's theory of moral development is interesting in the context of the main argument of this thesis because it suggests a framework for a sociocultural theory of moral development. Habermas's suggestion that learning to use language reflexively represents a transition between structured stages of communicative competence is lent some support in two more empirically based accounts of children learning to communicate, those of Wood (1992) and Halliday (1993).

Taking the perspective of others in dialogue has obvious implications for moral development which are stressed by the Citizenship curriculum used in the school. On Habermas's view what Kohlberg calls the 'postconventional' stage of moral development cannot be adequately characterised in developmental terms because

to decide upon moral norms within a community requires actual engagement in free and open debate amongst all those affected by the norms (Habermas, 1979). In other words, the end point of moral development is not an individual stage but a collective process characterised by the ground rules of the ideal speech situation.

The theoretical perspective which has been argued for in this thesis, particularly in Chapters 2 and 3, suggests a close connection between what has been called 'cognitive development' and what has been called 'moral development'. Both, it is claimed, are grounded in the process of induction into cultural practices particularly various versions of the core cultural practice of communicative rationality, although they emphasise different aspects of this core practice. Some recent empirical research also supports this relationship. For example Lake's investigation of the effectiveness of Lipman's philosophy for children (Lake, 1988) with a class of 10 year olds found that as a result of this 'thinking skills' enhancement programme they showed reduced levels of aggression and an improved capacity to listen to others. Kutnick's recent work on the effects of teaching such 'social skills' as 'trust and sensitivity' to primary children suggest that cognitive development is enhanced as much as 'moral' development (Kutnick and Marshall, 1993).

A language-based approach to science education

In Chapter 2 the pragmatist philosopher Rorty was quoted arguing that the core of scientific method could not be tightly defined in advance, but amounted to a situated cultural practice which depended on what he called 'attitudes' and 'habits' such as 'relying on persuasion rather than force' and arranging 'the sort of encounter in which truth cannot fail to win' (Rorty, 1991). This description of science is similar to the list of 'communicative virtues' given by Burbules and Rice quoted in Chapter 2 and implies, as Rorty brings out, that there is no clear demarcation possible between scientific rationality and reasoning in other areas of social life.

Lemke (1991) makes a similar argument through a sociocultural study of secondary science education. Science, Lemke argues, has its own specialised ways of using words or 'thematic patterns' but these rely on the same basic semantic relations as are used to construct 'thematic patterns' in other subjects. Lemke writes that, as well as learning thematic patterns, learning science involves learning certain genres or 'conventional formats for organising scientific reasoning, talking and writing' (*ibid.* p 153). Although some of these genres are specific to science they are based on practices, such as reasoning, which are general to all subject areas.

A sociocultural view of science education appears to be gaining ground. Cavalli-Sforza and colleagues (Cavalli-Sforza, Weiner, and Lesgold, 1995) argue, in the context of developing software support for science education, that the central scientific skills are those required for 'argumentation' which they define as a:

> process of proposing, supporting, criticising, evaluating and refining ideas, some of which may conflict or compete, about a scientific subject. (*ibid.* p 578)

Cavalli- Sforza *et al.* go on to write of 'knowledge-building conversations' as a potent medium for conceptual change in science. This case for the centrality of argumentation is similar to that which was made in Chapter 2 of this thesis, except the argument in Chapter 2 went further in proposing a socially situated definition for that core practice of science.

The Science Processes and Concepts Exploration (SPACE) project have produced reports on the development of primary children's scientific ideas across the science curriculum (see, for example, Russell and Watt, 1990) which emphasise the role played by learning scientific language. This project has developed elicitation techniques to explore children's initial conceptions in an area before developing ways of allowing children to develop their own ideas in the direction of the concept being taught.

The research of the SPACE project also confirms Lemke's stress on the importance of the correct use of key words to learning in science. Key words often have an everyday context and a science context. The difference between these two contexts needs to be explicitly taught and children need to be given the opportunity to use these key terms in new ways in the context of classroom discussion.

A team led by Howe at Strathclyde University have conducted a series of studies of children working in groups at science tasks both with and without computers (Howe *et al.*, 1992; Howe, Tolmie, and Mackenzie, in press; Tolmie *et al.*, 1993). Although working within a Piagetian rather than a sociocultural paradigm these studies have led to two conclusions which are very relevant to this thesis. The first is that computers can be used to shape the direction of pupil dialogue in science (Tolmie *et al.*, 1993). The second is that if groups of pupils with different initial conceptions of a problem are encouraged to make explicit predictions before conducting an experiment and to compare this with the outcome then their learning of the relevant concept, measured on a delayed post-test, appears to improve in relation to groups which shared a similar initial conception of the problem. (Howe *et al.*, in press). Howe *et al.* speculate that this is a result of interaction and cognitive dissonance between the different conceptions. They conclude:

> our results suggest that software which emphasises the testing of predictions will not be sufficient to produce the greatest learning gains. What will also be wanted if computer support for *collaborative* learning is really the issue, is software that obliges pupils to make their predictions fully explicit, and come to agreement ..... it seems to us that, in forcing an elaborated step-by-step process in the representing of predictions on a computers screen, computer software may have a unique role to play (*ibid.*)

In Chapter 4 of this thesis a survey of studies of collaborative learning was used to argue that the key factor was not a difference in initial conceptions of the problem but the use of an interaction style which encouraged the critical discussion of different perspectives before reaching agreement. The conclusions of the

exploratory studies in part I of this thesis indicate that software alone cannot, as Howe *et al.* appear to suggest above, oblige pupils either to be explicit or to reach agreement. One of the central arguments of this thesis is that these beneficial effects of discussion, which Howe *et al.*'s studies have demonstrated in the area of science, do not require that pupils hold different initial beliefs but can be achieved through the prior coaching of the interaction style of exploratory talk which encourages children to discuss different possible points of view in a critical but cooperative manner.

Developing software to support reasoning through talk within the curriculum

The design of the software was influenced by the guidelines for designing software to support exploratory talk given in chapter 4, research on pedagogy in the areas of primary Science and primary Citizenship surveyed above, the relevant sections of the National Curriculum as applied in the school and discussions with the class teacher.

Prototypes of both items of software were tested with groups of year 5 (age 9 and 10) children in a school other than the target school. Two groups of three children were video-taped using both items of software. The results of this prototype testing fed back into the development process.

The citizenship curriculum

The software was designed to be used in conjunction with a curriculum pack for citizenship (Rowe and Newton, 1994). This pack was based on Kohlberg's model of development and incorporated elements of the methodology of philosophy for children (Rowe, 1992; Rowe and Newton, 1994). It was sponsored by the Home Office and designed to meet the guidance on citizenship education in the National Curriculum and in the official criteria for school inspection.

The principle author of the curriculum described it as 'conflict-based' (Rowe, 1992) expressing his adherence to Kohlberg's Piagetian view that 'cognitive dissonance' between views and experience or between views in a discussion is the stimulus to change in moral frameworks. At the same time the introduction to the pack lays stress on the significance to moral development of the empathy that can arise from the shared expression of feelings in a small group or class. The main method of teaching recommended is to use stories, pictures and role-plays as a basis for both small group discussion and whole-class teacher-facilitated discussion in which the views and feelings of children can be expressed, questioned and reflected upon. Preliminary evaluation of the use of the pack indicate that this curriculum is successful in enhancing moral development measured on the standard instruments which have been developed to assess Kohlbergian stages (Don Rowe, personal communication).

The citizenship software

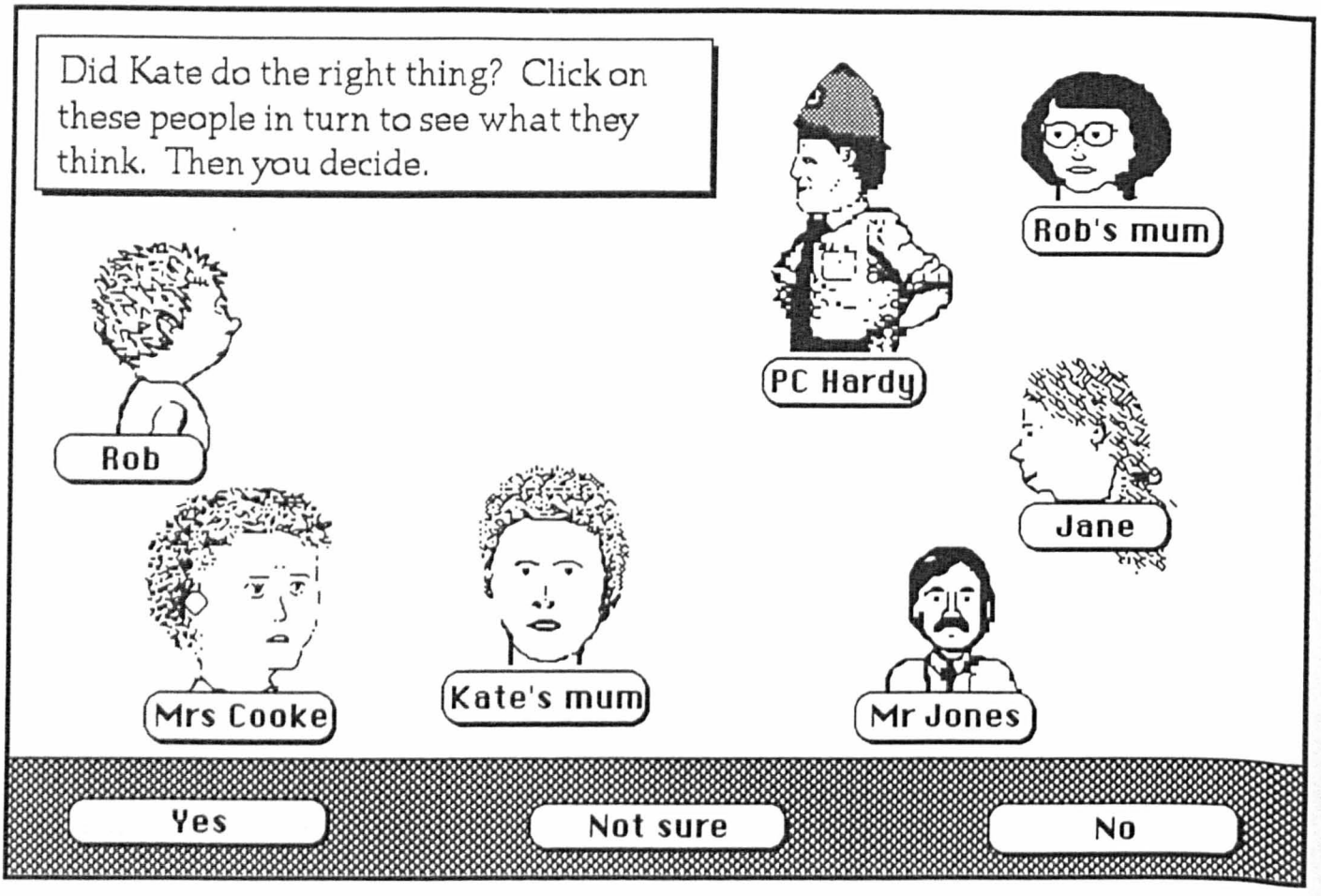
The citizenship software was specifically designed to be used with the 'Property and Power' unit of the citizenship curriculum pack where the issue of stealing is raised through a story about two kind shopkeepers, Mr and Mrs Shah, who are worried about children who are stealing sweets from their shop. The aim of the software is to promote moral development through stimulating exploratory talk about the conflict between personal morality (loyalty to a friend) and social morality (stealing is wrong) and through leading children to consider different perspectives before coming to a moral decision.

The scenario takes the form of a branching narrative about a girl called Kate who has promised her friend Robert that, if he tells her a secret, she will not tell anyone else. The secret he tells her is that he has stolen a box of chocolates. Should she tell straight away? Should she tell her mother when she asks her? Should she tell the shopkeeper? If Kate does not tell anyone she finds herself put under increasing pressure until she herself is accused of the crime. The children have to make

decisions as to what Kate should do or say at key junctures in the story, and these decisions determine how the story continues. At the end of the story the group are asked if they made her 'do the right thing'. If she had refused to tell anyone and herself taken the blame then Robert confesses. Finally the group are asked to consider Robert's punishment. These two final choices of the story, 'Did Kate do the right thing?' and 'Robert's punishment', contain icons of all the main characters with pop-up text speech bubbles giving their views. The group of users are asked to consider the views of these characters before reaching a decision.

The software was developed in HyperCard 2.2 , a multi-media applications environment for the Macintosh computer. There is a time delay of five seconds on each screen to stop the effects of multiple clicking on the movement icon and to encourage time for reflection at each card. The children are asked to enter their group name at the beginning of the software and at the end of the scenario the children find a printed version of their story consisting of a description of their route through the branching paths of the narrative. This can be printed out for further use in class. When used the software automatically records the amount of time that is spent at each screen.

Figure 4. Near the end of the story the users have to decide collectively whether they made Kate do the right thing or not



The science curriculum

The collaborating teacher suggested that the software in the area of science education focus on plant growth because this was something which was difficult to teach using the established method of growing watercress from seeds. The main problem with this traditional method was, she noted, that the time between setting up the conditions of growth and being able to measure the outcome was so great that the children could not connect the two. She was concerned that the length of time it normally took to conduct experiments on plant growth meant that the experimental process itself could not easily be taught. It has been noted that computer simulations of processes that are difficult to observe directly can be

effective in helping learners to acquire an intuitive as well as a conceptual understanding of theoretical concepts (Laurillard, 1992). For these reasons it was decided to design a simulation of plant growth.

The collaborating teacher worked closely to the National Curriculum Orders for Science. She believed the majority of the children in her class to be between attainment targets 2 and three in Key Stage 2.

Some relevant extracts from the new simplified orders of the National Curriculum are as follows:

> 'Pupils should be taught that plant growth is affected by the availability of light and water, and by temperature' (Living Processes.3.a)
> 'Pupils should be given opportunities to:
> a) ask questions related to their work in science
> b) use focused exploration and investigation to acquire scientific knowledge, understanding and skills' (Science.1)
> 'Pupils should be taught:
> - to make careful observations and measurements
> - to make comparisons and to identify trends or patterns in results
> - that making predictions can be useful when planning what to do
> - that changing one factor and observing or measuring the effect while keeping other factors the same, allows a fair test or comparison to be made
> - to indicate whether the evidence collected supports any prediction made
> - to try to explain conclusions in terms of scientific knowledge and understanding' (Experimental and Investigative Science)

As well as these guidelines the National Curriculum lists the attainment targets that pupils are expected to meet:

> **AT2:3** '(Pupils) provide simple explanations for changes in living things such as ... lack of light or water altering plant growth'
>
> **AT1: 3** 'Pupils respond to suggestions, put forward their own ideas and, where appropriate, make simple predictions. They make relevant observations and measure quantities, such as length or mass using a range of simple equipment. With some help they carry out a fair test recognising why it is fair. They record their observations in a variety of ways . They provide explanations for

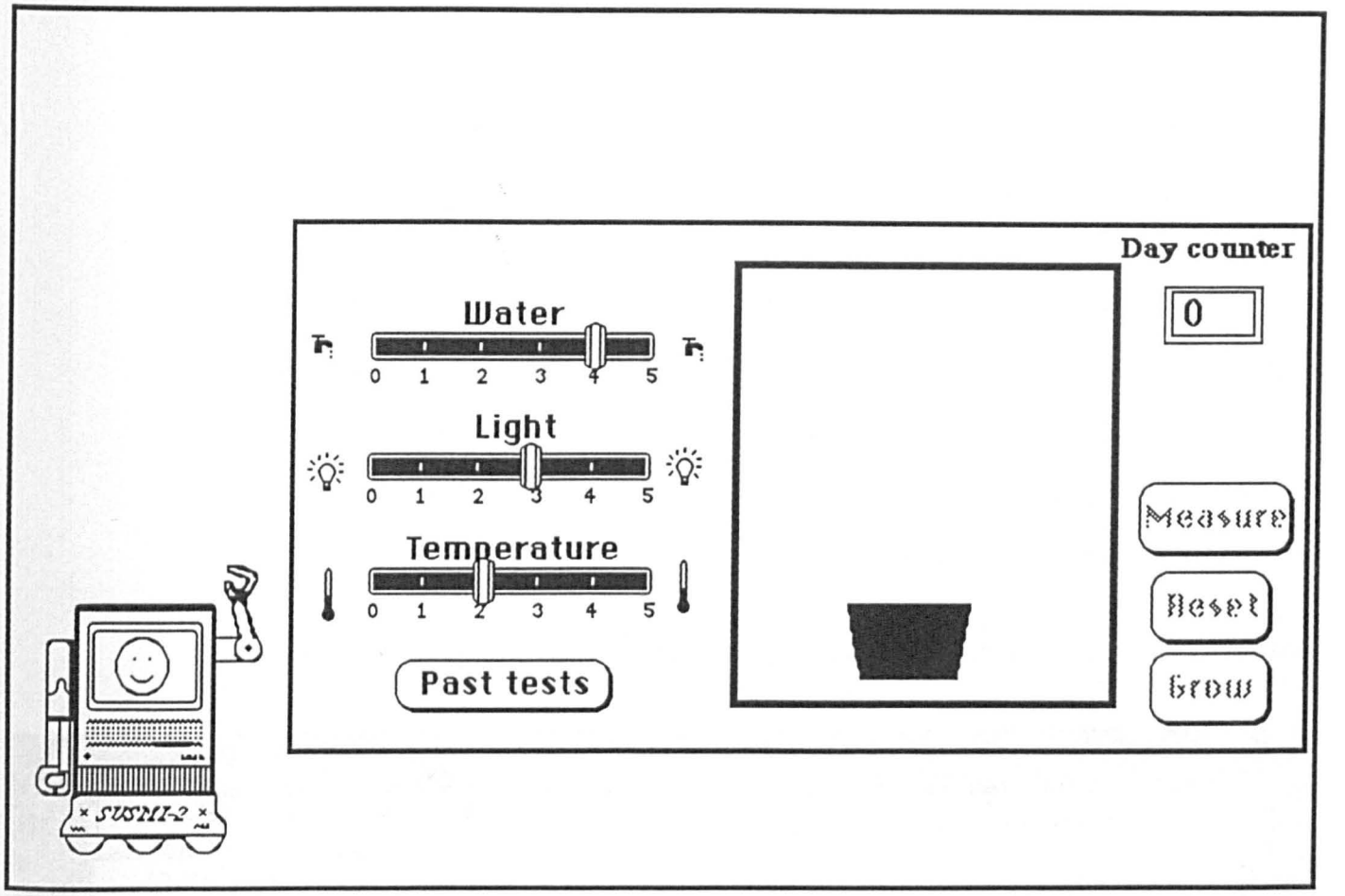
observations and, where they occur, for simple patterns in recorded measurements'

The software for science education was designed to be relevant to all the above educational aims and objectives.

The science software

Like the citizenship software the science software was developed in HyperCard 2.2, a high level applications environment for the Macintosh. It is more complex than the citizenship software, incorporating simple animation, sound and colour. Its basis is a simple simulation in which the three variables of light, temperature and water quantity can be altered and their effect measured on the growth of a flower.

Figure 5. The laboratory for experiments on plant growth



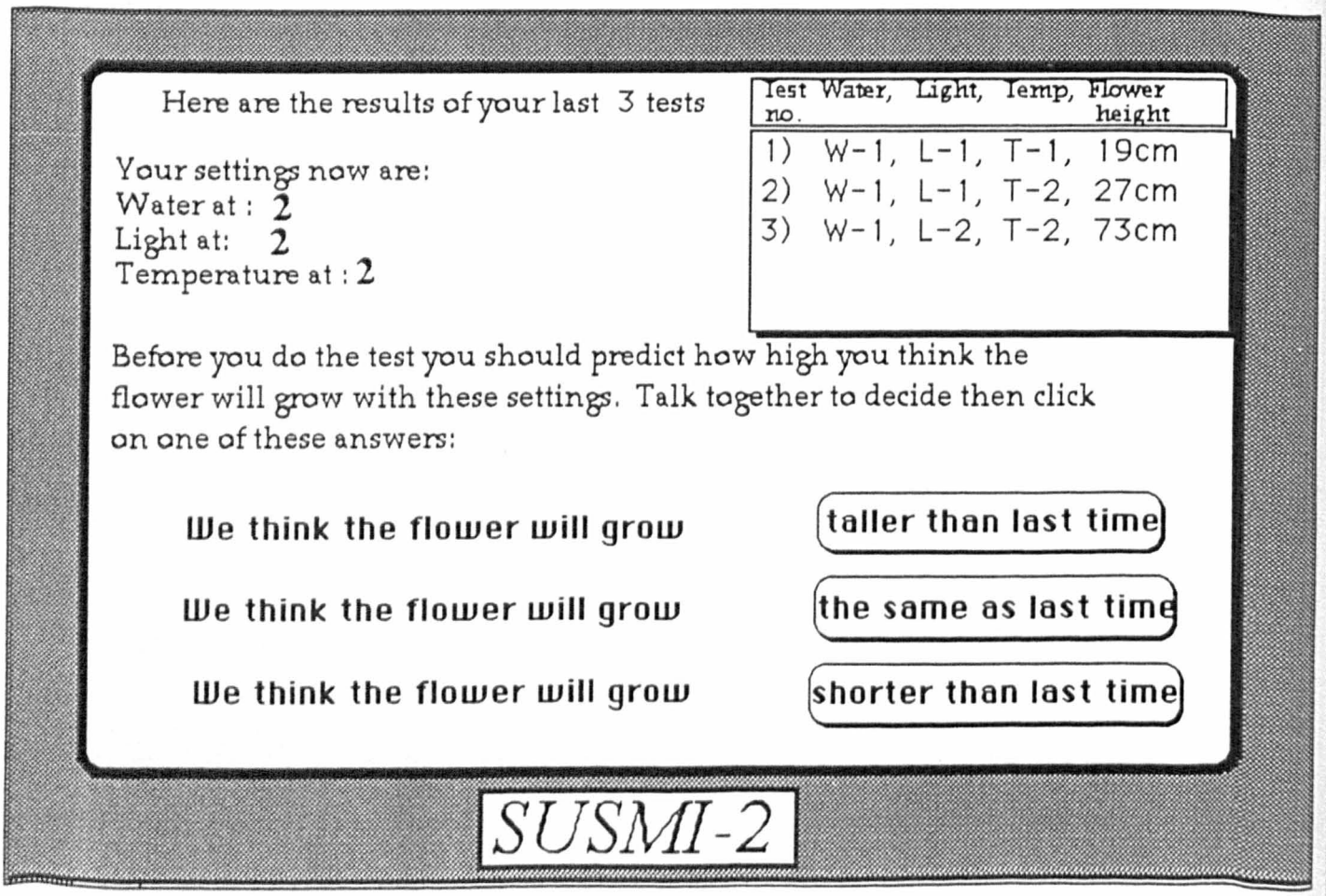
Narrative and role-play

Following the understanding of the intellectual role of narratives developed in Chapter 3 and the guidelines for software design developed in chapter 5, this simulation is embedded in a narrative. A group of children called 'the Scientists' are asked by a friendly gardener called Fred to help him to win the local flower show by finding out for him the best formula for growing a 'funflower'. When the group of users find the best formula Fred thanks them and then he is shown winning the flower show and getting a round of applause.

Talk-support module

The talk support module is adapted from some successful features of Tolmie and Howe's task design (Tolmie *et al.*, 1993). When the children have chosen the strengths of the different variables, but before they can get the plant to grow, they are challenged and asked to predict how high it will grow. After they have measured the flower growth but before they can reset the laboratory to try again they are asked if their original hypothesis was right or wrong and they are asked to explain why this is so. Here they are given a choice between talking together or typing a few words. To help them reason together a table is provided with the results of their past tests. This table can also be accessed from the laboratory screen where they decide on the settings.

Figure 6. A prompting screen encouraging the pupils to discuss explicit predictions



The prompts to talk together and other hints are provided by a helpful computer who is introduced in a brief tutorial at the beginning of the programme. This figure is visible in Figure 5.

In the background the software records the length of time the group of users spend at each card.

The relationship between the settings and the plant growth can be changed by a hidden database. Access to this database requires a password.

The classroom programme

Background

The lesson plans of the EPIC, as well as their actual implementation, were a product of close cooperation between the teacher and the researcher. Their development was influenced by the findings of the empirical study reported in chapter 3, the work of Karin Murris (1993), the Oracy Project (Open University, 1991) and the teacher's considerable experience in teaching oracy skills (e.g. Dawes, 1994).

After discussions with the class teacher it was decided that the EPIC as a whole would consist of five generic lessons in exploratory talk followed by two lessons linking exploratory talk to the area of citizenship, one lesson linking exploratory talk to the area of science and then the use of both items of software for each group of children. As well as this core time when the researcher worked with the teacher, the teacher also determined to integrate group discussions into other areas of the curriculum. Each of the lessons was designed to last about 45 minutes and the other aspects of the programme were to be fitted around these lessons when time was available.

For the group work in the programme it was decided to divide the class into groups of three. The groups would be carefully arranged by the teacher to include

both sexes, one child with learning difficulties and one good reader (necessary for reading instructions from the computer screen). As far as possible these groups were to be maintained throughout.

Promoting language awareness

The theme of language awareness starts with the first lesson and continues throughout the programme. All lessons in the programme, including the pre- and post- group exercises which will be described in more detail in the next chapter, are to be explicitly called 'talking lessons'. At the beginning of each lesson the teacher makes the aims of the lesson very clear in terms of the way she would like to see the children interacting. At the end of each lesson she summarises what has been learnt in terms of the goal of talking together more effectively. Children are encouraged to think about how they are talking to each other. One possible exercise is to show short sections of video of groups of children talking together in the course of collaborative work and to discuss them with the whole class.

'Circle time', is an exercise in which the whole class sit in a circle on the floor and discuss issues either suggested by the teacher or arising from the children. This will be introduced after the first two lessons and will continue at least once a week elsewhere in the timetable. This period gives an opportunity for the practice of the exploratory talk that has been developed mostly in small group work to be applied to the whole class.

After some practice of group work ground rules for talking together are to be elicited. First groups of three are asked to think of some ground rules then a representative from each group writes a ground rule on the black board. Each rule is discussed as a class in a teacher-led discussion. The resulting list is to be written on a poster and put up on the wall. In the actual implementation of this programme the resultant list read as follows:

Ground Rules for Talk

1. Everyone should have a chance to talk
2. Everyone's ideas should be carefully considered
3. Each member of the group should be asked
- what do you think?
- why do you think that?
4. Look and listen to the person talking
5. After discussion, the group should agree on a group idea

The generic exploratory talk lesson plans

1. *Talk vocabulary*

Whole class and group discussion of different types of talk followed by making a wall display using words and phrases to do with different types of talk.

This is an introductory lesson to raise awareness of talk and interaction and to give children the vocabulary to discuss together their own use of spoken language.

2. *Sound tapes*

Tapes of mysterious sounds are played to the children who are seated in their groups. The children listen to the sounds, discuss in their groups what was heard and report back to the class.

The aim of this lesson is to coach careful listening and reaching a group decision.

3. *Building copies*

Each group are given two sets of construction toys. Two children in each group are seated back-to-back so that they can not see each other's work and one has to build a model and describe to their partner how to replicate it. The third member of the group observes and comments on how they are communicating.

This lesson coaches the need for clear expression, active listening and asking for clarifications.

4. 'Dog's home'

Each group are given pictures of six dogs and descriptions of only five potential owners. Each group has to decide which dog would suit which owner, and which dog will end up unwanted and so will end up being 'put down'. Their choices are discussed in a whole-class session. Then groups have to invent a new owner to rescue the dog that they had not found a home for before.

This lesson specifically coaches integrated reasoning through talk. The evidence given to the children has to be used to construct arguments for and against different dogs going to different owners and to determine which dog will be left behind.

The bridging lessons for citizenship

5. Getting on with people

This exercise uses a set of pictures from *You, Me, Us*, the citizenship curriculum pack, of groups of children in different stances and arrangements. These are used for whole class and group discussion about the issues involved, e.g., bullying, helping a friend, and so on. After discussion each the groups devise a short play to present to the class.

6. Shoplifting

A story from the *You, Me, Us* citizenship curriculum pack is read out and discussed by the whole class and then in groups. The story is about kind shopkeepers, Mr and Mrs Shah, who suffer from children stealing from their shop and do not know what to do about it. Each group devises a play about stealing and presents it to the class.

Both these citizenship lessons provide an opportunity for the children to use the ground rules for talking together to discuss and reach agreement on the moral

issues that arise in everyday life and then to work together to produce a joint product in the form of a play.

A bridging lesson for science

7. Looking for links

Each group receive a worksheet with various pictures of living creatures, boats, furniture, etc. They then talk about the best way to put these things into groups.

At the beginning of this lesson the teacher and the researcher are to model a critical, questioning but cooperative dialogue about how to categorise the elements on the sheet. The teacher stresses both that the task is open-ended and all claims had to be supported with reasons.

At the end of the group discussion period the teacher directs the class towards some scientific bases for classification.

This lesson coaches the application of reasoning to classification in science.

Computer-based work

In the last week of the programme the two specially designed items of software are to be used by all the groups in the class.

6.4 Summary and conclusion

This chapter has given the background to the EPIC and outlined its design. The design development and implementation of the EPIC took the form of a close partnership between the researcher and the teacher. The programme uses various methods to raise children's awareness of the significance of their use of spoken language and how they can, working as groups, use it more effectively. In the generic lessons exploratory talk is coached as a style of talk independent of content area. The bridging lessons suggest ways in which this style can be applied

to the specific subject areas of citizenship and science. At the end of the series of lessons the children are to work in groups around the two specially devised items of software designed to support them in applying this style of talking to these two subject areas.

This chapter has described the EPIC entirely from an educational point of view. But as well as serving pedagogic aims this EPIC was also an intervention programme in a quasi-experimental study serving research aims. The next chapter, chapter 7, will discuss methodological issues in educational research and outline the design of the evaluation of the EPIC.

Chapter 7 Methodological issues in the design of the evaluation of the main study

7.1 Introduction

This chapter situates and justifies the design of the evaluation of the main study through a critical discussion of relevant methodological issues. The chapter is in three parts. In the first section an epistemology consistent with the arguments of this thesis is developed out of a critique of the broad 'quantitative – qualitative' divide sometimes drawn in educational research. The second section and main body of the chapter considers the strengths and weaknesses of different approaches to the study of collaborative learning and discourse in education. The final section draws conclusions from this discussion and applies them to the design of the evaluation of the main study.

7.2 The big paradigm debate

Versions of the quantitative-qualitative divide

There are various forms of the idea that there is a major paradigm divide in educational research. Usually these claim that the choice of different research methods is determined by an underlying epistemology. Because versions of this idea often characterise the two sides through the kind of data they focus on, qualitative data or quantitative data, the 'quantitative-qualitative divide' has been used as a generic term for all of them (Hammersley, 1992). A sophisticated version of the great divide model was put forward by Willis in a recent paper (1995). Willis contrasted the 'empiricist/objectivist' paradigm with the 'interpretivist' paradigm: the first, he claimed, leads to research which aims 'to discover lawlike generalisations about external reality' while the second led to research which aims 'to understand in context'.

Forman describes a slightly different version of this great divide model and relates it directly to the methodology of research on peer collaboration (Forman, 1994). The epistemological dichotomy Forman uses to ground her version of the divide is that between individualistic perspectives based on a 'cranial storage metaphor' and sociocultural perspectives which locate cognition in 'situated activity'. The first leads, she claims, to experimental methods of research which focus on individual learning and seek to control the 'extraneous variables' of the context while the second, because of its focus on action in context, leads to the rejection of these methods in favour of a variety of strategies.

Another version of this great paradigm divide is described by Cazden in a survey of research on classroom discourse. Cazden (1986) writes that there are two main traditions that have developed in near isolation from each other. She calls one the 'process-product tradition' and describes this as concerned with coding and counting categories of talk which are then considered as variables influencing the 'product' or learning outcome. The other main tradition, according to Cazden, is the 'descriptive' or 'sociolinguistic tradition' which works from 'qualitative analyses of excerpts of actual classroom talk', and eschews categories:

> until it becomes clear in the course of the research which categories of behaviour are meaningful to the participants themselves. (*ibid.* p 433).

Cazden's version of the great divide does not then focus on an opposition between 'experimental' and 'natural' settings but on the opposition between deductive methods which apply a pre-coding scheme to classroom discourse and inductive methods which deduce codes and theory from the data. Like Willis, quoted earlier, Cazden suggests that the division she describes in research on educational discourse relates to a larger controversy in educational research between 'positivist' and 'interpretivist' paradigms.

Criticisms of the quantitative-qualitative divide

If it is true that there are two big 'package deal' paradigms in educational research the job of choosing an appropriate methodology would be simplified. On this model fundamental epistemological commitments determine either adopting one complete package or the other. However there are various reasons why this is not an adequate solution.

Snyder (1995) brings out some of these reasons. She first claims that there are two main research paradigms which she typifies as the 'quantitative' which aims at 'objective' knowledge and the 'qualitative' which rejects objectivity in favour of describing participant perspectives on reality. However she goes on to argue that each has strengths and limitations in such a way that they can be combined to good effect. The qualitative approach does not support strong generalisable claims while the quantitative approach is often insensitive to contextual issues influencing the research. By combining them in a classroom study she claims that she achieved 'multiple perspectives' which produced more convincing results than either methodology could have achieved alone.

Hammersley disagrees with Snyder that there are 'quantitative' and 'qualitative' paradigms which can be usefully combined. He surveys the variety of actual educational research that has been conducted and concludes that the idea that there are two major competing research paradigms is unhelpful to the design of research because it obscures the real range of strategies available and 'misrepresents the basis on which decisions should be made' (1992, p 172). In reality, he claims, the research process has several aspects:

> formulating problems, selecting cases, producing data, analysing data, communicating findings (1994)

And each of these aspects can be approached through a range of strategies. He does, however, agree with Snyder that there are trade-offs to be made in choosing between different strategies and methods. Instead of two big paradigms facing

each other he appears to propose a number of continuous scales. He proposes, for example, that experimental and naturalistic methods are joined by a continuum: at the one extreme the laboratory experiment provides strong evidence for claims but its findings lack 'ecological validity' - meaning that they are not necessarily relevant to 'real world' contexts - while at the other extreme the naturalistic case study offers strong ecological validity but less chance of finding the appropriate data needed to test hypotheses. He also suggests that inductive and deductive methods should not be separated but seen as united in larger research programmes in an iterative cycle of exploration and testing:

> ... it seems to me that all research involves both deduction and induction in the broad sense of those terms; in all research we move from ideas to data as well as from data to ideas. What *is* true is that one can distinguish between studies which are primarily exploratory, being concerned with generating theoretical ideas, and those which are more concerned with testing hypotheses. But these types of research are not alternatives; we need both.(Hammersley, 1992, p168)

Hammersley's view appears to be gaining ground. In a critical review of research on classroom discourse, Edwards and Westgate argue against devotion to a single approach and in favour of choosing methods appropriate to the research task (1994, p 60). Mercer (1995b) similarly concludes an account of the sociocultural perspective in research on classroom discourse with an appeal to openness:

> Perhaps what is most required is a willingness to consider a range of methodological options, and to avoid reducing methodological problems to simplistic choices (such as that between 'quantitative and 'qualitative' methods).

However there is a problem with Snyder's argument which might also prove to be a problem with Hammersley's. If the two different paradigms Snyder calls 'quantitative' and 'qualitative' really are grounded on different and incompatible views of the nature of reality then it seems difficult to see how they can be simply combined to give complementary perspectives. Proponents of versions of the quantitative-qualitative divide such as Willis and Forman would argue that methods are not simply neutral tools but have philosophical presuppositions

associated with them. Findings from methods that presuppose an objective and fixed external reality cannot be simply juxtaposed with findings from methods that presuppose that reality is a cultural construction. The assumption Snyder implicitly makes is that the two sets of methods deal with the same reality but this assumption is precisely what, she herself claims, is in question.

Hammersley's argument is not that we should ignore the philosophical presuppositions of research methods but that philosophical consistency allows for a lot more combinations than the proponents of the qualitative-quantitative divide acknowledge. However he too assumes a realist epistemology which needs to be spelt out. The claim that different research strategies relate not to different and incompatible world views but simply to different moments in the research process implies that all research is inter-communicable with other research in a single shared human project. This is not an unproblematic assumption. To justify it the next section will argue not that inter-communicability of research is grounded on an objective world, a very difficult case to make, but that it can be grounded on the communicative process through which shared perspectives are continuously being constructed.

A communicative epistemology

There is considerable overlap between this debate about methodology and the debate about rationality in chapter 2. In that chapter a way was sought beyond the opposition of universalist and context-bound accounts of rationality. Variations on this same philosophical opposition underlie some versions of the opposition between 'quantitative' and 'qualitative' or 'experimental' and 'naturalistic' methods in educational research. This similarity is not surprising. Arguments about the nature of rationality are inevitably also arguments about the nature of knowledge construction.

In chapter 2 a solution to the dilemma of rationality was found by following Habermas's shift from a focus on methods of reasoning or their absence to a focus on the ground rules of effective communication between different perspectives. This position also suggests the possibility of a consistent epistemology linking the positions associated with the different sides of the 'quantitative-qualitative' debate. It is not enough, as Willis appears to argue, to seek only understanding in a context because the ground rules of communicative rationality imply an aim at universality. However a universal context shared by all cannot be assumed. Shared reality is always under construction in the process of debate. The idea of an objective reality is translated into the idea of the universalising process of creating intersubjective understanding. While knowledge can be laid down and appear as 'truth' in the context of later dialogues, this laid down context is always open to the possibility of being questioned and dug up again. The tools of this knowledge-constructing debate are not, and cannot be, formal methods guaranteeing truth but are whatever methods are found to be persuasive in the social and historical context (Rorty, 1992; Habermas, 1991; Lakatos, 1978).

This communicative epistemology offers the possibility for this thesis of being self-reflexively consistent in two ways. Firstly it is consistent with the advocacy throughout this thesis of free and open dialogue oriented towards consensus as the optimal situation for knowledge construction in collaborative learning. Secondly it suggests a coherent epistemological basis for the development of a research methodology.

7.3 A survey of relevant research methods

This section surveys different approaches that have been taken to the study of collaborative learning and discusses their strengths and weaknesses. This discussion is necessary to justify the choices that were made in the design of the evaluation of the main study.

Experimental methods

There have been a considerable number of experimental studies of cooperative learning with computers. Some of these were summarised in Chapter 4 where research evidence was explored in search of a characterisation of the optimal conditions for effective cooperative learning. From this summary it can be seen that the experimental method has proved useful in indicating that some factors are more significant than others in producing desired educational outcomes – for example that the quality of interaction is more significant than differences children may have in their initial understanding of a problem area.

Limitations of experimental research methods in investigating children's cooperative learning at computers have recently been pointed out by two researchers who have conducted some of the most influential research in this field. Paul Light and Karen Littleton (in press) summarise a series of experiments which, while producing interesting and valuable results, have also consistently pointed to the impossibility of controlling for all significant factors in a realistic way. They found, for example, that initial marked differences between pairs and individuals working at the same computer task evaporated if the individuals, instead of being isolated, were asked to work individually but with peers working in the same room. This and other experimental results consistently pointed to the significance of an invisible social context formed from the perceptions and interpretations of participants. Light and Littleton's concluding paragraph is worth quoting in full:

> Developmental psychologists working in a number of fields are gradually coming to appreciate the all pervading nature of contextual effects on cognition (e.g.. Forman, Minick and Stone, 1993; Light and Butterworth, 1992). One aspect of this belated shift involves the recognition that the 'social context' of a cognitive task embraces not only direct interpersonal interactions but also the social norms, expectations, representations and comparisons which condition such interactions. In the end, taking this wider sense of 'social' into account in our research may turn out to demand richer and more diverse research methods than those used in

> the research reported here. Nonetheless, our rather tightly circumscribed experimental approaches have perhaps justified themselves, at least to the extent that they have served to highlight their own limitations! (*ibid.*)

At their best, experimental methods enable systematic comparisons to be made between different conditions from which clear and persuasive conclusions can be drawn. However experimental methods run the risk of producing results which are highly influenced by the controlled experimental conditions and so are not generalisable to normal life (Mercer, 1995, p94). Light and Littleton's experimental research suggests both that the 'social context' of learning is a crucial 'variable' and that it is not easily accessible to analysis through controlled experiments.

Action research

Hammersley (1992) argues that one difficulty with the divide some have drawn between naturalistic research and experimental research (e.g. Issroff, 1995) is the difficulty in separating natural from artificial settings. The classroom is a socially constructed realm in which it is natural for teachers to 'experiment' with lesson plans and styles of teaching and to evaluate the results of their 'experiments'. In the 'action research' model teachers are called upon to become the researchers of their own classrooms and schools. Carr and Kemmis (1986), for example, use Habermas's early work to argue for a research activity which contributes to the emancipation and enlightenment of teachers through their engagement in 'a self-reflective critical community committed to the development of education' (*ibid.* p5).

Two objections to the action research model are that it does not take into account both the serious interest that many groups other than teachers have in the evaluation of educational methods and the need for professional expertise in research. While sympathetic to the action research approach, Mercer (1995, p 119) suggests that it suffers from a failure to engage sufficiently with perspectives from outside of the teaching profession and is wrong to oppose more detached kinds of

research and the role of external researchers. Mercer suggests that a better model for sociocultural research would be that of a 'research partnership' in which researchers and practitioners work together collaboratively to their mutual advantage. This expansion out of the model to include a larger community of interested participants can maintain some of the valuable insights of action research. In particular the artificial division between 'pure' research and 'applied' education, which persists in both naturalistic and experimental approaches, can be overcome if that research is situated in the self-reflective practice of a community of all who are concerned with education.

The value of Mercer's research partnership model for the proposed study is that it suggests a way of combining some of the 'ecological validity' of naturalistic research with the intervention and systematic evaluation needed to test hypotheses.

Approaches to discourse analysis

'Process-product'

The term 'process-product' is taken from Cazden who writes that:

> In the process-product tradition, the independent variables to which measurements of learning outcomes are related include frequencies of categories of talk, for example higher order questions or teacher praise. (1986, p433)

In chapter 2 a range of studies of the relationship between process and product in children's collaborative learning were surveyed and summarised. Many of these studies use coding schemes to categorise talk by the function of utterances. King's study (1989) is exemplary of this type of research and relevant to the research aims of this thesis. A measurable problem-task was given to groups of children and a coding scheme was applied to their talk as they solved these problems. The coding included categories such as: 'short statements', 'long statements', 'questions' and the use of various problem-solving strategies. The results of this coding were

carefully analysed using statistical techniques and it was found that, of all the categories, asking questions was the most significantly correlated with problem-solving success. From this finding King draws the instructional conclusion that it might be useful to coach the use of task-based questions in classrooms.

Both the usefulness and the validity of such coding schemes have been questioned. Draper and Anderson (1991) bring out four problems:

1) Utterances are often ambiguous in meaning making coding difficult or arbitrary.

2) Utterances may have – indeed often have – multiple functions simultaneously, which is not recognised by most coding schemes.

3) The 'phenomena of interest to the investigator ... may be spread over several utterances' (*ibid.* p 99)

4) 'meanings change and are re-negotiated during the course of the ongoing conversation, and often it is impossible to be sure what was meant by what was said.' (*ibid.* p 99)

Edwards and Westgate sum up the limitation of coding schemes as an inability to properly allow for the complex way that meaning depends upon context:

> ...no talk can be interpreted without reference to its context and that fact brings its own severe problems once it is recognised that contexts are not fixed frames of reference within which talk takes place and has its meaning, but are themselves talked into being, renewed or challenged. (1994, p 171)

Crook (1994) similarly argues that what is of interest in studying group interaction is the development of shared knowledge over time, but coding schemes necessarily miss this 'temporal' dimension in cooperative talk, reducing all encounters to atemporal 'inventories of utterances' (*ibid.* p 150).

Coding schemes offer the promise of enabling systematic comparisons to be made between talk in different contexts. Their disadvantage is that, precisely by abstracting aspects of talk from the context in which they occur, they risk a loss of meaning.

'Insightful observation'

'Insightful observation' is a term given by Stubbs (quoted in Edwards and Westgate, 1994) to describe Douglas Barnes' early influential work on group interaction in classrooms (Barnes, 1976). In contrast to the 'process-product' style of research described above Barnes used classroom observation and the interpretation of transcripts taken from the talk of children engaged in normal classroom tasks to explore the processes through which knowledge is shared and constructed. His approach relied on intuitive understanding gained through discussions with teachers and children and participation in the contexts described.

Edwards and Westgate argue that the strength of Barnes' early work lay in making easily taken for granted aspects of classroom life 'visible' and so available for reflection and that the value of this can be seen in the recognition his insights gained immediately from many teachers (Edwards and Westgate, 1994, p58). However they also quote many critics of Barnes' method (*ibid.* p108), especially as this has been used by some others. It is easy, they write, to pull transcript evidence out of context in order to illustrate a case already made and so to offer 'only the illusion of proof'. They appear to support Stubbs' criticism (*ibid.*) that this method is not sufficiently principled and relies too much on the privileged knowledge that the researcher has of the context which simply has to be taken on trust.

Conversational Analysis

Conversational analysis (CA), like Barne's work, focuses on the 'interactional accomplishment of particular social activities' (p17): how participants construct contexts and shared meaning over time. The units of analysis are not utterances

but 'sequences of activity'. According to Drew and Heritage (Drew, 1994) one way in which conversational analysis overcomes the criticisms which have been directed at 'insightful observation' is through not assuming a privileged knowledge of the context. Instead of immediately interpreting the meaning of talk, the reader is given enough transcript to come to their own conclusions. CA studies:

> are concerned to show that analytically relevant characterisations of social interactions are grounded in empirical observations that show that the participants themselves are demonstrably oriented to the identities or attributes in question. (*ibid.* p 20)

A sociocultural perspective

Mercer writes that the sociocultural approach to classroom discourse has a considerable methodological overlap with other approaches such as CA but can be distinguished from them through its central concern with the development of knowledge and understanding in discourse (Mercer, 1995b). In this it is influenced by Vygotsky's characterisation of language as a psychological tool. Mercer describes this further as a focus on discourse as 'a social mode of thinking' and offers the beginnings of theoretical frameworks for looking at the cognitive dimension of teacher's and learner's talk together as well as at the talk of collaborating peers. (Mercer, 1995A) The latter framework, the linked typifications of disputational, cumulative and exploratory talk which emerged from the SLANT project, has been described in detail in chapter 5.

Like CA, Mercer's sociocultural approach must rely on presenting short selected texts. Yet often – certainly in the evaluation of educational approaches – analysis requires generalisations beyond these samples. In chapter 6 , for example, some theoretical ideas about the limitations of more directive software which were proposed by Fisher on the basis of sociocultural analyses of a small number of transcripts were shown to be inadequate through the use of a quantitative technique which could generalise the claims and so test them against a larger

amount of transcript data. This suggests that the sociocultural method, often apparently based on the close analysis of small fragments of transcript, while effective for generating theories is not always so effective for testing those theories or for supporting strong comparative conclusions.

It is sometimes possible to show causal relationships in the data through the methods Mercer describes and he demonstrates this on a number of occasions. For example, one transcript excerpt he presents (1995a, p 12-13, 'Maximum box') shows clearly and convincingly how a learner is led to understanding of a mathematical problem through exploratory talk with two peers. However Hammersley's point (1992) that it is generally more difficult to show causal links or to test hypotheses using observational rather than experimental data is a valid one. Hammersley's analysis is supported by Snyder's personal account of her difficulty in answering her research question, the question of the impact of computers on writing skills, through observational methods alone.

The linguistic approach to discourse analysis

In chapter 5 the work of linguists Sinclair and Coulthard (1975) was referred to. Sinclair and Coulthard approached spoken language in the classroom as a coherent linguistic system which could be analysed through its internal hierarchical and sequential organisation on the model of a grammar. Stubbs, perhaps the leading representative of the tradition of discourse analysis established by Sinclair and Coulthard, criticises some more sociological and psychological approaches to discourse studies for using linguistic features while ignoring their full linguistic context (Stubbs, 1986). He writes that much research moves from looking at isolated linguistic features to make claims about social and psychological variables without pausing to consider the role of those linguistic features in a discourse system. Stubbs argues that the relationship between language and educational processes cannot be captured by the *ad hoc* study of

particular features, for example the use of questions, but requires an understanding of language as a system of communication.

The work of Sinclair and Coulthard in the 1970s has been highly influential. Aspects of their approach have been incorporated by others in the field (Lemke, 1990; Mehan, 1979) as well as into the argument of this thesis. However their approach has also been criticised firstly for simplifying or ignoring the social and psychological context of language use (Mercer, 1995a; Drew and Heritage, 1992) and secondly for not dealing directly with the content of talk (Edwards and Mercer, 1987). Drew and Heritage note specifically that the pursuit of formal models can lead to the conflation of linguistic rules and social relations. They refer, for example, to the way Sinclair and Coulthard described certain ritual classroom exchanges as features of 'coherence' in discourse when other approaches would have drawn attention to the social context constructed by a traditional pedagogical theory which closely specified appropriate pupil responses and enforced these expectations with the threat of punishment. They claim that this problem with the linguistic approach to discourse analysis is related to a 'bucket' view of context as a pre-established social framework containing actions. In contradistinction to this formal linguistic approach, they claim that is necessary to look at the content of talk and the way in which it is used to achieve mutual understandings and construct shared contexts.

Computer-based text analysis

Sinclair's most recent work, referred to by Stubbs (1993) reflects the growing role of new technology in linguistics. The recent volume published in honour of Sinclair includes articles illustrating the impact of computer-based text analysis in the field of descriptive grammar, dictionary production, stylistics, the analysis of bias in texts and discourse analysis (Baker, Francis, and Tognin-Bonelli, 1993).

Stubbs, a leading proponent of a linguistic approach to discourse analysis, has recently argued that computer-based text analysis can solve some of the problems faced by traditional methods. One of these, noted earlier, is the frequent limitation of such methods to the careful analysis of relatively small transcripts. Stubbs argues that studies based on the presentation of fragments of recorded talk can be insightful and plausible but raise 'problems of evidence and generalisation' (Stubbs, 1994). It is often not clear, Stubbs continues, how such studies could be replicated and compared or how they could lead to cumulative progress in the field. Although Stubb's arguments are directed towards the analysis of discourse as a linguistic system they could equally apply to more sociological and psychological approaches. This is evident when he writes that:

> Subjective decisions are always involved in the choice of text and linguistic features for analysis. But computer assistance means that exhaustive and objective searches may be possible for all examples of a feature. (*ibid.* p 204).

Graddol has developed a software tool specifically to apply a computer-based approach to the analysis of transcripts of talk (Graddol, 1993; in press). He argues that the use of Key Word In Context (KWIC) searches of electronically stored text can dramatically speed up the iterative cycle of exploration and testing involved in any analysis of discourse (Graddol, in press). This iterative cycle often combines close exploratory 'qualitative' work with generalisation and testing of hunches about linguistic features across the whole of a text or series of texts. The use of such techniques for written transcripts of spoken language offers the possibility of systematic comparisons of language use in different settings without losing sight of the relationship between particular linguistic features and their context within transcripts.

7.4 Design of the evaluation of the main study

This section of Chapter 7 draws out the principles that emerged from the discussion in the previous sections and uses them to develop a design for the evaluation of the main study.

The research questions

From the discussion of research paradigms in the first part of this chapter it emerged that one important basis for the selection of research methods should be their appropriateness to the research task. The communicative epistemology proposed above suggests that another question to ask in selecting methods is: Which methods will provide the most persuasive evidence for a potentially universal audience?

The research questions to be answered by the evaluation of the main study are those questions which emerge from the exploratory studies described in the first half of this thesis. These questions are as follows:

1 Does the amount of exploratory talk produced by groups in collaborative work in the classroom increase as a result of coaching in exploratory talk ?

2 If so does that increase in the use of exploratory talk lead to increased scores on group reasoning tests?

3 Do individuals increase their scores on individual reasoning tests as a result of coaching in exploratory talk?

4 Can the quality of children's interactions when working together at computers be improved by coaching exploratory talk?

5 Can computers be used effectively to support the teaching and learning of exploratory talk?

6 Can computer supported group work serve to integrate peer learning with directed teaching?

A quasi-experiment

Research questions 1 to 4 above suggest the need for systematic comparison between children who have been coached and those who have not. The discussion above of the trade-off between experimental and naturalistic methods suggests that such comparisons are best pursued through quasi-experimental research design. As Snyder argues from her experience (Snyder, 1995, p 52) comparing case studies alone cannot produce as convincing results as a quasi-experiment.

The proposed study centres on one class of children who will be coached in exploratory talk through an EPIC the details of which will be developed and implemented in close cooperation with a teacher on the research partnership model. As well as this target class, three further 'control' conditions are suggested by the research questions:

- A 'normal' class who have neither coaching nor software to provide a control for the use of reasoning tests.
- Groups of children external to the target class who use the software without having been coached in exploratory talk.
- Groups of children internal to the target class who have been coached in exploratory talk and do not use the software, but work away from the computer instead on tasks with similar educational objectives.

Sociocultural discourse analysis

Systematic comparisons can only offer answers to some types of research questions, not to all. Take question 6, for example: Can computer supported group work serve to integrate peer learning with directed teaching? If transcript

evidence can show that this did happen on at least one occasion then it can show that this it is a possibility – that indeed computers can serve to direct children's talk towards pre-specified curriculum ends – and that would be interesting in itself regardless of how many times this happened or with how many groups.

To answer these types of question the best method to use is the sociocultural approach to discourse analysis developed by Mercer and described above. This method follows the development of shared understanding over time and presents it in a way that makes it evident to the reader.

On the other hand some questions ask for an element of generalisation across instances in order to make comparisons between conditions. For example: Can the quality of children's interactions when working together at computers be improved by coaching exploratory talk? From the discussion of methodological issues it emerged that the danger of making such comparisons on the basis of abstracted surface linguistic features is that the essential activity of using language to understand can easily be missed. The problem posed by this is how to combine fidelity to the meaning of a transcript while generalising its features in order to compare it to other such transcripts. One possible answer to this dilemma might lie in the use of computer-based text analysis.

Computer-based text analysis

KWIC stands for 'Key Word in Context', a method increasingly used with large scale electronic corpora to explore changes in word meaning and create modern dictionary entries (Graddol *et al.*, 1994). !Kwictex, a software tool for the analysis of transcripts developed by Graddol, enables the same technique to be used for the analysis of transcripts. This software allows for the rapid implementation of the exploration and testing cycle in the study of transcripts without actually leaving the context of words and 'codes' behind. The immediate contexts of key words and combinations of key words can be abstracted from the transcript to a

separate list. At the same time the words are highlighted in the main text which can be returned to instantly at any time. Clicking on an abstracted 'turn at talk', for example, returns this to its place in the full transcript. At one extreme this software offers the possibility of a complete quantitative breakdown of turns at talk and language use - at the other it offers the possibility of working closely with full transcripts.

Dynamically interrelating different levels of data

In his critique of the 'quantitative-qualitative' divide Hammersley suggested that cycles of induction and deduction were found in all types of research. This suggests that one way to creatively combine descriptive and naturalistic research with more deductive and experimental research is to bring out the dynamic relations between these two approaches in the full research cycle. Discussion of Graddol's approach to the computer-based analysis of transcripts suggested a way in which this cycle could be accelerated and brought to the fore in discourse analysis.

The evaluation of the main study will extend the scope of the cycle of exploration and testing made possible through the use of !Kwictex, to include measurable group test results. The aim will be to be able to interrelate group test results with linguistic features and episodes of talk such that one can both show quite concretely how talk leads to the solution of a problem but also be able to abstract features from that talk and compare them across problems, groups and conditions.

The method proposed is 'dynamic' in two senses. Firstly the generation of the analysis out of iterative cycles of exploration and testing dynamically interrelates the concrete/local and abstract/general poles of the data. Secondly the analysis must be interpreted dynamically. The aim is not to reduce the study to a single finished meaning, but to offer sufficient resources for the reader to generate an understanding of the study as a whole by dynamically interrelating different levels of data and analysis. The ideal is to produce research in which the context is

not hidden behind a finished abstract analysis but that equally the presentation of context does not substitute for rigorous and systematic interpretation.

7.5 Summary and conclusion

This chapter has presented an outline of the methodology of the main study. The choices made in this methodology have been explained and justified through a critical discussion of different traditions in the study of collaborative learning and educational discourse. An epistemological basis consistent with the arguments of the thesis was developed through a critique of the broad opposition sometimes drawn between 'quantitative' (objectivist) and 'qualitative' (interpretivist) approaches to research. The strengths and weaknesses of experimental approaches were considered and a quasi-experimental approach adopted for one aspect of the research task. Similarly the strengths and weaknesses of the action research methodology were considered and a 'research partnership' methodology adopted for another aspect of the research task. A variety of approaches to the study of educational discourse were discussed. From this discussion it emerged that the research task demanded the development of a new methodology of discourse analysis based on the combination of the sociocultural approach developed by Mercer and recent developments in computer-based text analysis.

Chapter 8 Evaluation of the EPIC: Coaching exploratory talk

8.1 Introduction

The evaluation of the EPIC is designed to explore two distinct but related question areas. The first area is the coaching of exploratory talk and the role of exploratory talk as a social mode of thinking. The second is the educational role of the computer as a support to exploratory talk within the curriculum. This chapter will focus on what the results of the evaluation of the EPIC have to say about the coaching of exploratory talk while the next chapter, chapter 9, will focus on the role of the computer.

These two aspects of the evaluation overlap. The pedagogic aim of the EPIC was not simply to coach exploratory talk in the context of specially devised tasks but as integrated into the normal curriculum. Computers were used to integrate exploratory talk into normal curriculum learning so the effectiveness of the EPIC in coaching exploratory talk cannot be properly assessed without looking at the talk of children working at the computer.

This chapter is structured like an experimental report, with sections on aims, method, results and discussion. However this structure does not mean that the study can entirely be assimilated into the established model of psychological experiments. As was explained in Chapter 7 this is a hybrid study combining aspects of two very different traditions - the tradition of experimental psychology and the tradition of sociolinguistic discourse analysis. In the latter approach, like the ethnographic method on which it builds, data, results and analysis are intertwined in a single text. To accommodate this the results section is in two parts comprising a section on the quantitative data gathered through the use of

reasoning tests and its statistical analysis, and a section analysing the talk of the children engaged in group reasoning tests.

8.2 Aims

The pre- and post-intervention comparisons in the main study were designed to test and explore the following hypotheses:

- That the amount of exploratory talk produced by groups in collaborative work in the classroom would increase as a result of having been coached in exploratory talk through the EPIC.
- That increase in the use of exploratory talk would lead to increased scores on group reasoning tests.
- That some individuals would increase their scores on individual reasoning tests as a result of coaching in exploratory talk.

The background to these hypotheses is given in chapters 2, 3 and 4.

Exploratory talk is a qualitative rather than a quantitative notion. To write of increases in the amount of exploratory talk does not imply that exploratory talk can be completely reduced to a measure of quantity. Nonetheless, as discussed in chapter 5, it is possible to assess whether a given passage of talk is more or less exploratory in focus rather than cumulative or disputational or another type of talk.

8.3 Method

Subjects

The target class was a year 5 (9 and 10 years old) class of 33 children in a local state middle school. The control class, who had neither the coaching programme nor the use of computers, were a year 5 class of 18 children in another state middle school in the same region. Both schools drew children from a catchment area with

a similar social and economic profile. For the purpose of the tests and many of the exercises in the intervention programme the classes were divided into mixed gender groups of three, eleven groups of the target class and six groups of three in the control class. In both classes the groups were established by the teacher to include a range of ability. Groups of all high ability children and groups of all low ability children were avoided.

The intervention programme

The intervention programme was that described in chapter 6. This programme consisted of four lessons designed to coach generic exploratory talk, two lessons which coached exploratory talk in the context of citizenship, one lesson which coached exploratory talk in the context of science, and two computer exercises which encouraged the children to use exploratory talk in these two subject areas. This programme was taught through one lesson of approximately one hour each week for seven weeks followed by the use of the computers over two days in the eight week.

The tests

Problems from Raven's standard progressive matrices were taken and used to form two tests of 27 questions each where the first two questions were not to be marked but used to explain the task to the class. (The tests are given in full in Appendix D.1 and D.2.) Using guidelines given in the Raven's manual (Raven, Raven and Court, 1991) these two tests were designed to be of approximately equal difficulty. One test was given to the children working together in their normal groups of three and the other was given to the children working individually two days later. In the group reasoning tests each group was given one book of tests and one answer sheet and they were asked to talk together to work out the problems. In the individual condition each individual was given a book of tests and an answer sheet and asked not to talk to other children but to

work alone. In each condition the class were shown how to do the tests. The first two questions in the booklets were shown to the whole class and they were asked for the correct answers. It was then demonstrated how to ring these correct answers on the answer sheet. The tests did not begin until it was clear that everyone understood the procedure. A time limit of 25 minutes was set.

Systematic comparison

The two tests described were given in the same order and in the same manner to the target and to the control class at the beginning and at the end of the period of the EPIC. Other than these tests the control class had no involvement with the programme at all.

Recording and transcription

Three groups in the target class were observed and recorded working together on the group reasoning test before the beginning of the EPIC and again nine weeks later after the EPIC had been completed. These groups were chosen by the teacher as representative of the range of ability and motivation in the groups in the target class. Two of these groups had two girls with one boy and the third group had two boys with one girl. On both occasions the three groups were given the tests in a separate room from the rest of the class with the researcher moving in and out to make sure everything was going well but not interfering except to respond to queries. (These transcripts are available in full in Appendix D.3 to D.8)

8.4 Results I: The test scores

This section will explore the quantitative data provided by the individual and group reasoning tests which were given both prior to and after the intervention programme. In the following analyses non-parametric tests of significance were used because the samples were small, the control and target classes were of a

different size, and it could not be assumed that the tests would produce a normal distribution. The software statistics package 'SPSS' was used throughout.

A: the results of the group reasoning tests

Target class group reasoning test results

The group reasoning tests were marked out of 25. The following table, table 5, shows the scores of the target class groups for which pre- and post-intervention matched scores were available (one group completed a pre-intervention test but not a post-intervention test). The differences between pre- and post-intervention scores show the change in score on this test over the nine week period of the intervention programme.

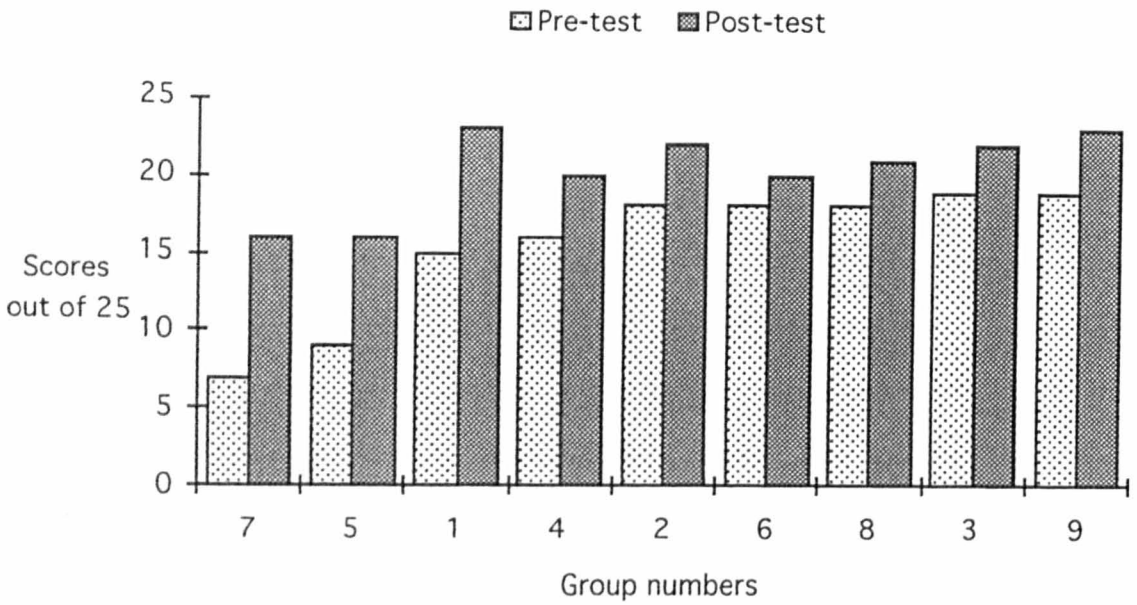
Table 4. Means of pre- and post-intervention target class group reasoning test scores.

	Pre-test	Post-test	Difference
Mean	15.44	20.33	4.89
SD	4.44	2.69	2.47

Table 4 compares the pre- and post-intervention test scores on the group reasoning test for the groups of the target class.

Representing the full figures graphically (figure 7) shows that each group in the target class increased its score on the group reasoning test.

Figure 7. Pre- and post-intervention target group reasoning test scores



These figures show a significant increase in the scores of groups on the group reasoning test over the period of the EPIC. ($Z = -2.66$, $p = 0.004$. One-tailed Wilcoxan test).

Control class group reasoning test results

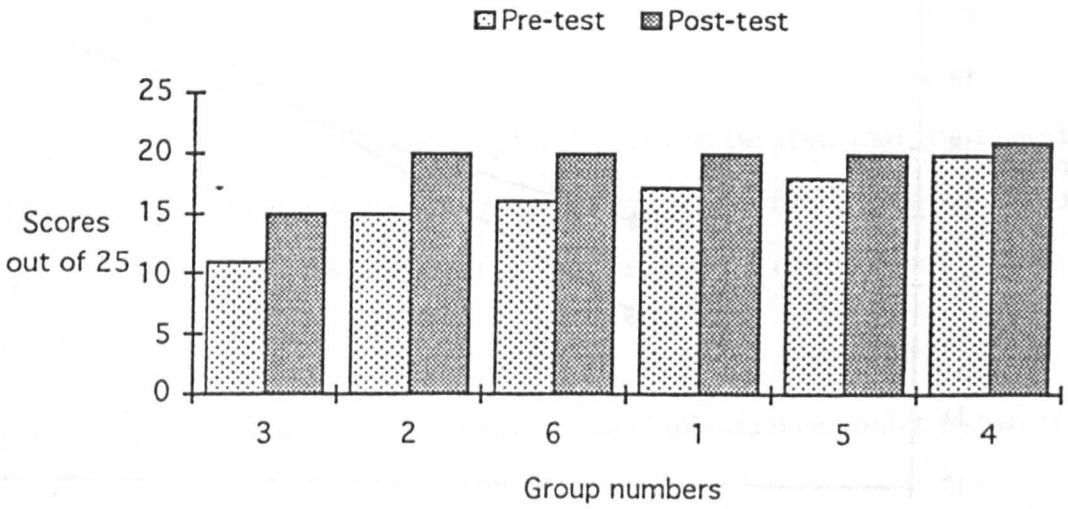
Table 5 shows the scores of the control class groups for which pre- and post-intervention matched scores were available (all of them in this case). The differences between pre- and post-intervention scores show the change in score on this test over the nine week period of the intervention programme.

Table 5. Means of pre- and post-intervention control class group reasoning test results

	Pre-test	Post-test	Difference
Mean	16.83	19.33	2.5
SD	3.19	2.16	1.37

Representing the group pre- and post-intervention test results graphically (figure 8) shows that, as with the target class, each group in the control increased its score on the group reasoning test. However it can also be seen that the increases were smaller than those of the target class groups.

Figure 8. Pre- and post-intervention control class group reasoning test scores

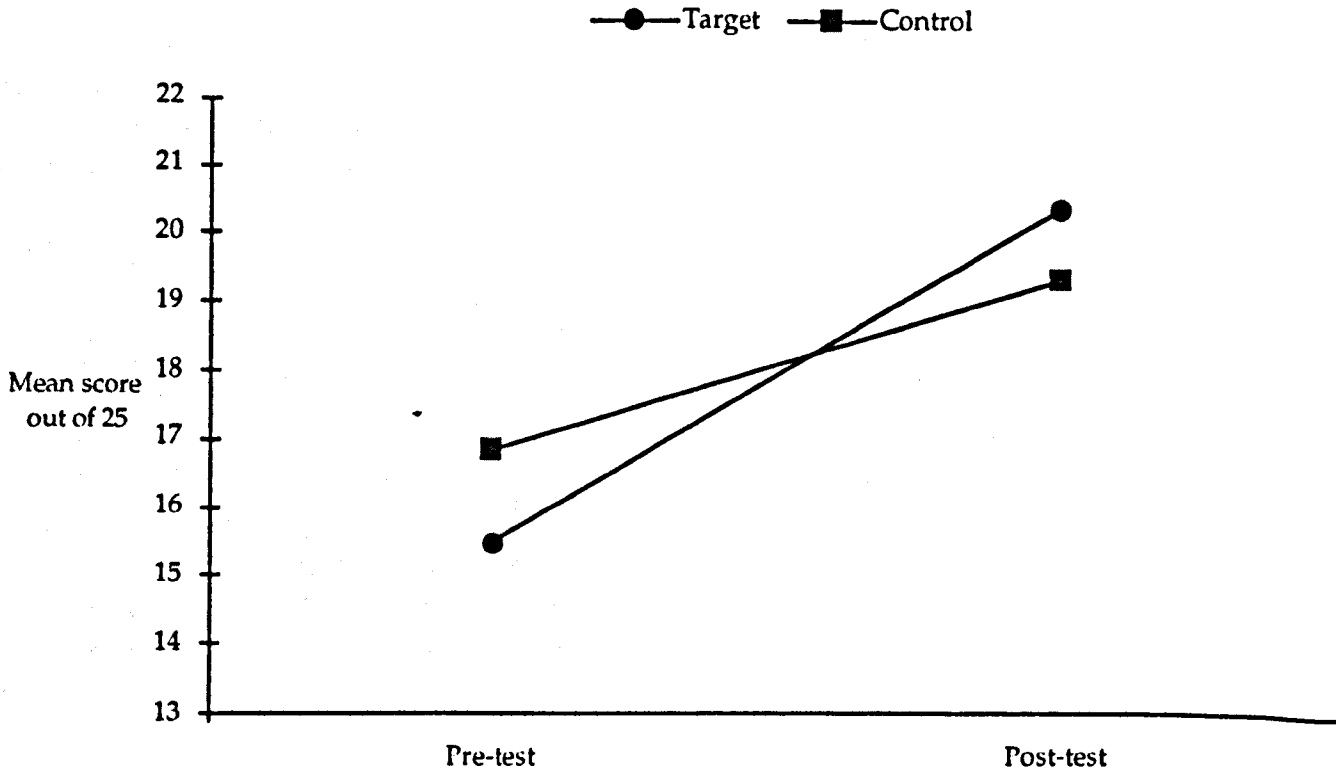


Applying the same test to these figures as to the figures of the group results for the target class produces a significant result. ($Z = -2.2$, $p = 0.014$. One-tailed Wilcoxan test). It should be noted however that the improvement in the target class scores was significantly larger than that in the control class and in fact four times less likely to have occurred by chance.

Means of the target and control class group reasoning scores compared

Figure 9 compares the pre- to post-intervention change in the mean score of the target class groups with the change in the mean score for the control class groups. It can be seen that both means improved, but that the target class mean improved more than the control class mean.

Figure 9. comparing the pre- to post-intervention change in the means of the target and control group reasoning tests



The differences between the pre- and post-intervention test scores for all groups in the target class were compared to the differences between the pre- and post-intervention-test scores for all groups in the control class and it was found that this difference was significant ($Z = -1.87$ $p = 0.031$. One-tailed Mann-Whitney test, corrected for ties).

B: the results of the individual reasoning tests

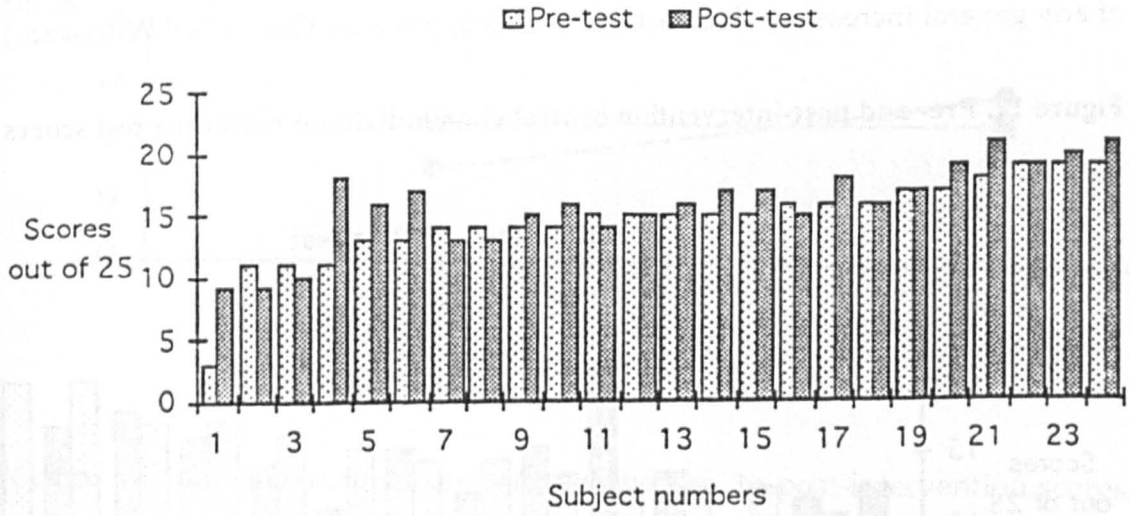
The individual reasoning tests were of a similar type and difficulty to the group reasoning tests. Table 6 shows the scores of the target class individuals for whom pre- and post-intervention matched scores were available. The differences between pre- and post-intervention scores show the change in score on this test over the nine week period of the intervention programme.

Table 6. Means of pre- and post-intervention target class individual reasoning test scores.

	Pre-test	Post-test	Difference
Mean	14.58	15.88	1.29
SD	3.41	3.37	2.24

Figure 10 shows the full results graphically. It can be seen that the majority of children increased their scores over the period and a few increased them by a large margin. The scores are arranged in ascending order based on the pre-intervention test.

Figure 10. Pre- and post-intervention target class individual reasoning test scores



Analysis of these figures suggested that they were statistically significant ($Z = -2.63$, $p = 0.004$. One-tailed Wilcoxan test). Other factors which should be taken into account in interpreting these figures will be discussed later.

Control class individual reasoning test results

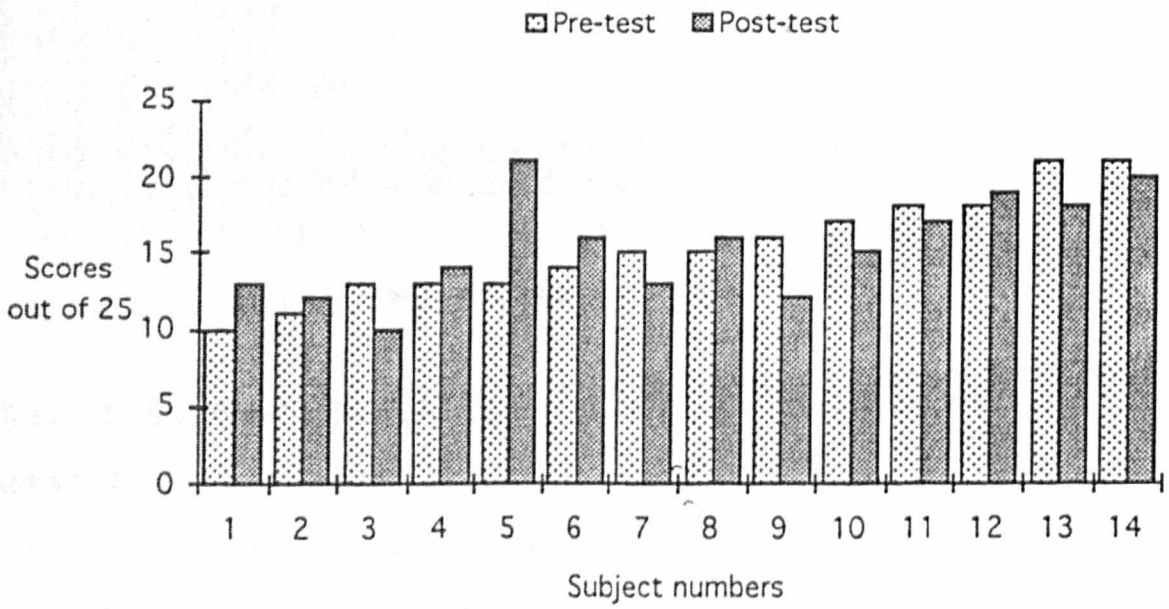
Table 7 shows the scores of the control class individuals for whom pre- and post-intervention matched scores were available. The differences between pre- and post-intervention scores show the change in score on this test over the nine week period of the intervention programme.

Table 7. Means of pre- and post-intervention control class individual reasoning test scores

	Pre-test	Post-test	Difference
Mean	15.36	15.43	0.07
SD	3.36	3.3	3.1

Figure 11 shows the full results graphically. It can be seen that there is no evidence of any general increase or decrease. ($Z = -0.345$, $p = 0.36$. One-tailed Wilcoxan.)

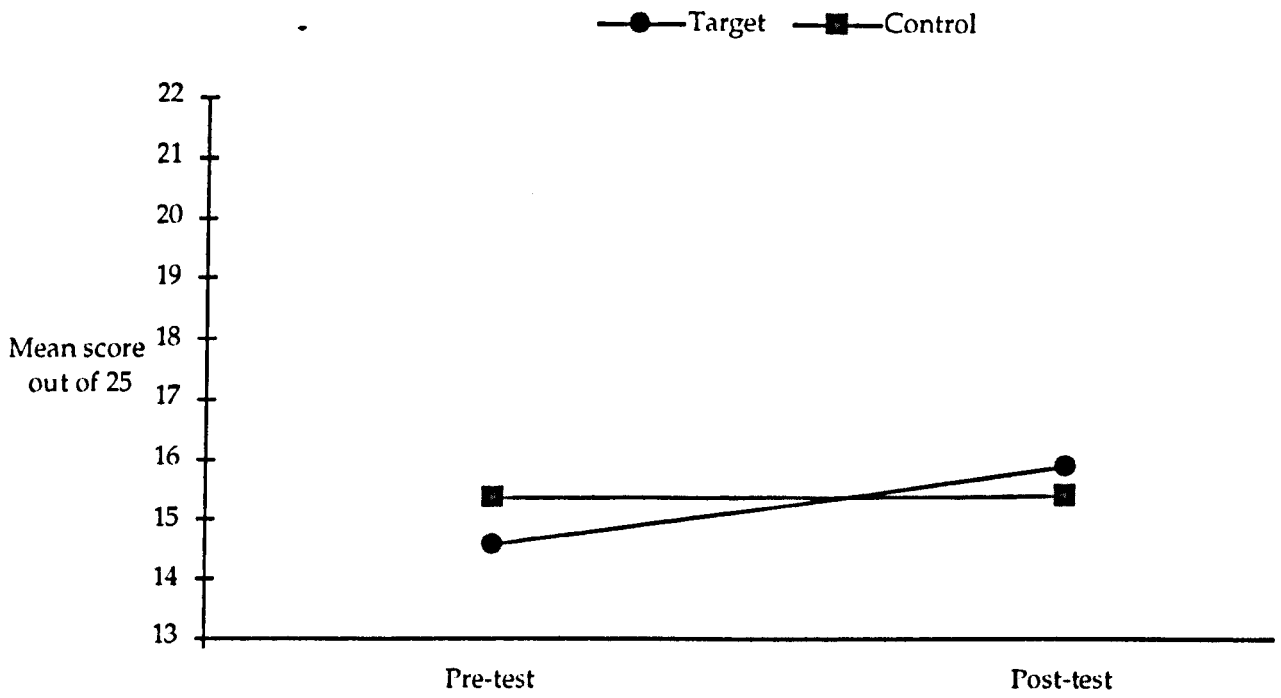
Figure 11. Pre- and post-intervention control class individual reasoning test scores



Means of the target and control class individual reasoning scores compared

Figure 12 compares the pre- to post-intervention change in the mean score of the target class individuals with the change in the mean score for the control class individuals. It can be seen that the target class mean result improved while that of the control class remained approximately the same.

Figure 12. Comparing the pre- to post-intervention change in the means of the target and control individual reasoning tests.



A comparison of the differences between the pre- to post-intervention scores of the target class individuals and the differences between the pre- to post-intervention scores of the control class individuals suggested that this result was significant ($Z = -1.65$, $p = 0.05$. One-tailed Mann-Whitney test).

Summary and conclusion

This section has presented the results of the pre- and post reasoning tests. These tests were given to the target and the control class children working both as groups and as individuals. Statistical analysis suggests that the pre- to post-intervention increase in the group scores of the target class was significant, both when considered on their own and when considered in relation to the change in result of the control class. The increase in individual scores in the target class, although apparently less marked, was also found to be statistically significant both when considered on their own and when compared to the change in individual scores in the target class.

Some of the context of these results will be explored in the discussion section of this chapter.

8.5 Results II: The talk of the target class focal groups

This second results section of the chapter looks at the way the children of the target class talked together while working on the group reasoning tests. The statistical analyses presented above offer circumstantial evidence that the coaching of exploratory talk had an effect on the ability of groups of children in the target class to solve the problems presented in the reasoning tests. This section will look at the interaction of the children in the target class while they worked on the tests. In this way it is possible to offer more direct evidence both that the style of their talk together changed as a result of the coaching programme and that this change led to improved scores on the group reasoning tests. The methods used for the analysis of the children's talk will be those introduced in chapter 7. This section will divide into two main parts. First a sociocultural discourse analysis of excerpts from the transcripts, focusing on three instances where groups in the target class failed to solve a problem in the pre-intervention test and went on to solve the same problem in the post-intervention test. Second the use of computer-based

methods to abstract elements from those episodes to generalise the analysis across all the available data. Although this section offers 'results', it should be stressed that in the tradition of discourse analysis being used the 'analysis' and the presentation of 'results' are integrated.

Sociocultural discourse analysis

The following analysis is based on data from classroom observation, from video and audio recordings and from transcripts. First an overview of the interactions of the three groups is given to provide some context. Next specific episodes are focused on. These episodes are related to problems in the group reasoning test. One problem is taken for each group which the group failed to solve in the pre-intervention test but succeeded in solving in the post-intervention test.

An overview of the interactions of the three focal groups

Focal group 1: Elaine, Graham and John.

This group were very noisy in the pre-intervention test. John was the ringleader, talking in silly voices into the microphone and 'playing around'. Elaine responded to his lead. Graham was quieter. Many of the questions were answered without any discussion at all. Elaine was in charge of the pencil. In the post-intervention test John was more subdued because he was feeling ill. Elaine was now determined to implement the exploratory talk practice which had been taught. Graham supported her in this. John, however, wanted to divide the task into separate roles: one (John!) to answer the questions, one to write down the answers and one to turn the page. This was directly against the group cooperative style that had been coached over the previous eight weeks. Elaine and Graham contested his attempt to control the group appealing to the authority of 'Mr Wegerif' (the researcher) and Mrs Dawes (The class teacher).

Group 2. Sujatta, Alan and Nora (pre-test)/Barbara(post-test)

This group were very quiet in the pre-intervention test and clearly not confident working with each other. Alan and Nora showed a certain deference to the opinions of Sujatta. In the post test they talked more and had a more confident tone. They appeared to work well together. Barbara, who had joined the class in early October, replaced Nora who had emigrated to Canada.

Focal group 3. Jane, Natalie, George

Jane and Natalie are both confident and both friends. In the pre-intervention test they worked together often excluding George. George complained about this. In the post-intervention test they made an effort to include George. In the post-intervention test Jane took the lead in turning the pages and asking questions. At the end Jane and Natalie differed on the answer to the final question and could not reach agreement. The argument became quite animated and continued into break with other members of the class involved.

In the pre-intervention test in general the task was not equally shared by all in the group but one or two took responsibility while others looked disengaged. In the post-intervention test all the children in all three groups were almost continuously occupied in the task.

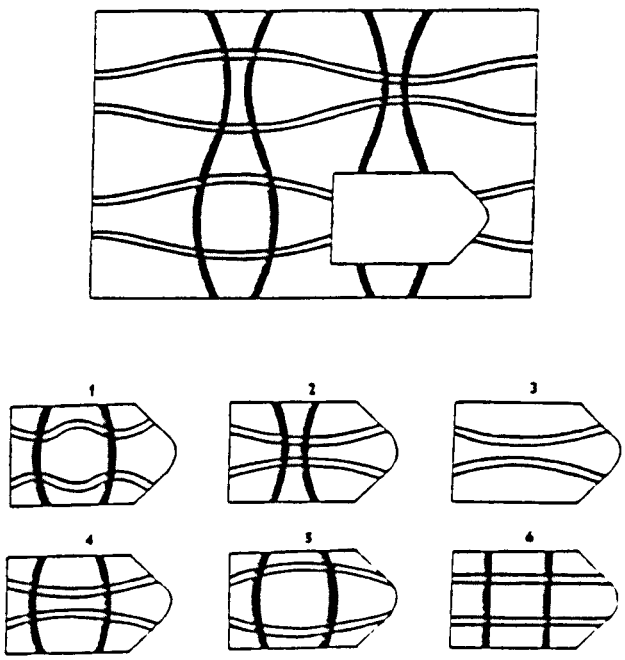
Relating episodes of talk to problem solving.

All of the three groups improved their test scores by several points pre- to post-intervention. (Figures can be seen in Table 4 and figure 7 shown earlier where these groups are labelled 1,2,and 3 as above). By attending to the contextual clues in the recordings it is possible to relate question numbers to the talk of the children. In this way the talk of the children while failing to solve a problem in the pre-intervention test can be compared to the talk of the children while succeeding in solving the same problem in the post-intervention test. This detailed analysis of

episodes of talk in terms of their pragmatic and 'cognitive' effect is an implementation of the sociocultural approach discussed in chapter 7.

Focal group 1 (Elaine, John and Graham) working on problem A11

Figure 13. Problem A11.



The pre-intervention test talk

John:	(Rude noise)
Elaine:	How do you do that?
Graham:	That one look
All:	It 's that (Elaine rings 1 as answer for A9)
Elaine:	No, because it will come along like that (Elaine rings 5 as answer for A11)
John:	Look it's that one (Elaine rings 2 as answer for B1)

(Appendix D, p 1)

The post-intervention test talk

John:	Number 5
Graham:	I think it's number 2

John:	No, it's out, that goes out look
Graham:	Yeh but as it comes in it goes this
Elaine:	Now we're talking about this bit so it can't be number 2 it's that one
Elaine:	It's that one it's that one
Graham:	Yeh 'cos look
Elaine:	4
Graham:	I agree with 4 (Elaine rings 4 as answer for A11)

(Appendix D, p 9)

Commentary.

In the pre-intervention test A11 was answered wrongly in a series of several problems which were moved through very rapidly. The other problems in this short series were answered correctly. Elaine's second utterance 'No, because it will come along like that' implies that one of the other two group members had just pointed to a different answer on the page. She gives a reason to support her view and this is not challenged. There is no evidence that agreement is reached before the answer is given. The group move on to the next problem. This episode occurs between episodes of distraction. Looking at the full transcript in Appendix D.3 it is apparent that the children do not take the task set very seriously and much of their talk is off-task.

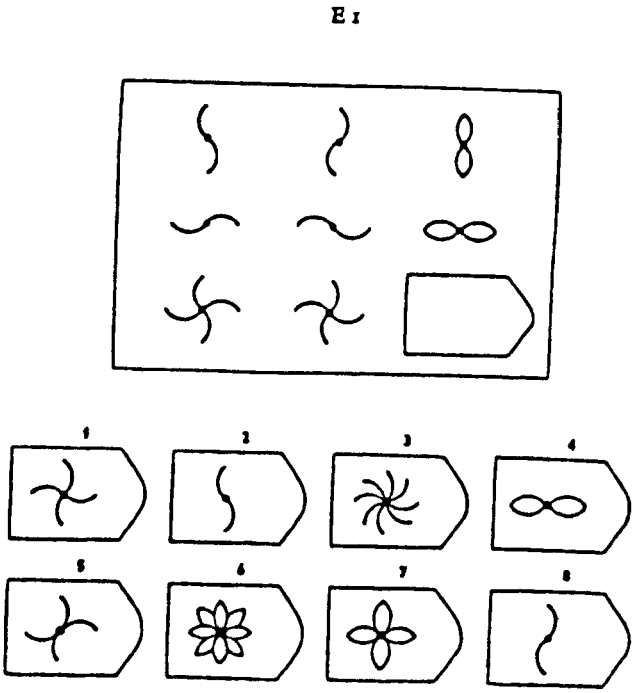
In the post-intervention test episode much more time is spent by the group on A11. Two alternatives are considered and rejected before the right answer is found and agreed on. This is crucial. In the pre-intervention test example only one alternative was considered and rejected before a decision was reached. The structure of the problem is such that, to be sure of a right answer it is necessary to consider at least two aspects of the pattern. John first spots the pattern of the dark vertical lines moving outwards and so suggests answer 5. Graham then spots the pattern of the lighter horizontal lines moving inwards and so contradicts John saying the answer must be 2. Just as Graham's reason means number 5 is wrong so John's reason means that number 2 is wrong. Elaine apparently sees this and so turns to number 4. Graham sees that she is right and points to confirming

evidence on the page. In the context of John's vocal objections to previous assertions made by his two partners his silence at this point implies a tacit acceptance of their decision.

Both episodes appear to contain exploratory talk (see chapter 4). Challenges are offered, reasons are given and the group appear to be working together. However the second episode includes a much longer sustained sequence of exploratory talk about the same shared focus. The main difference between the orientation of the talk in the pre-intervention test and the orientation of the talk in the post-intervention test was a shift from lack of engagement with the task set in the pre-intervention test to serious engagement with the task set in the post-intervention test.

Focal group 2 (Natalie, Jane and George) working on problem E1

Figure 14. Problem E1.



The pre-intervention test talk

Jane:	E1.
George:	We've only got three more to do.
Jane:	I know what it is.

Natalie: That, that (rings number 3 on the answer sheet).
(sound of page turning)
(Appendix D, p 20)

The post-intervention test talk

Natalie: E1.
(pause)
Natalie: Right I know. Wait a minute - look, that and that and that and that and that and that together - put it all together and what do you get ? You get that.
George: Yeh, 'cos they've all got a dot in the middle.
Natalie: Wait a minute.
Jane: I actually think it's ...
Natalie: I think it's number 6.
George: Or number 7?
Natalie: Who agrees with me?
George: No it's number 7 'cos that and that makes that. Number 7 yeh?
Natalie: Yeh.
Jane: Number 7. E1 (rings number 7 on the answer sheet).
(Appendix D, p 26)

Commentary

In the pre-intervention test extract the girls appear to find an answer for this problem using a cumulative style. Jane suggests an answer and this is accepted without challenge by Natalie who rings the answer. George is not involved.

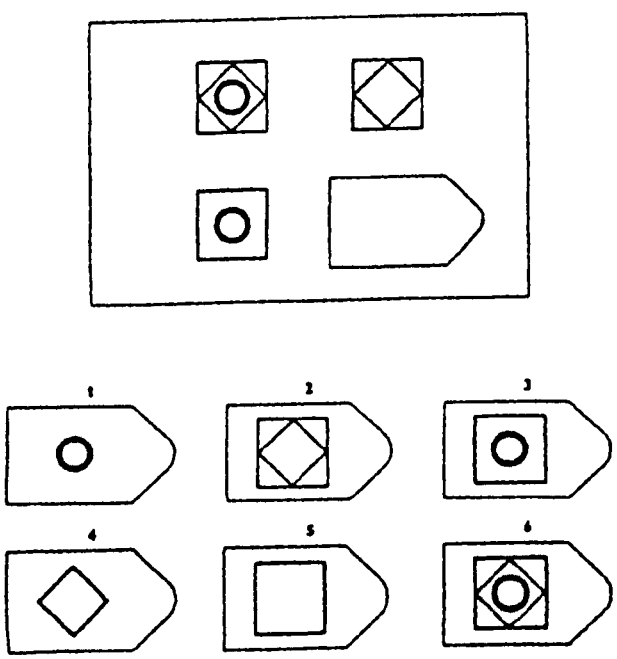
In the post-intervention test Jane and Natalie each propose an alternative before George sees the correct answer. Both Jane and George give explicit reasons for their claim. On the video the two girls can be seen pausing to think about George's suggestion, which he backed up with arguments, before agreeing with it. The ground rules of exploratory talk which are being followed in the post-intervention test encourage more alternatives to be proposed than were proposed in the pre-intervention test and then lead to each alternative being critically considered.

In the pre-intervention test George was often ignored by the two girls. He can be heard on the recording complaining about this. After the coaching programme

focal group 2 asked many more questions and many of these were in the form : 'What do you think George?'. The effect of this was to draw George into the decision making process. On his own in the individual test George scored slightly less than either of the two girls, but here we can see his contribution moves the group forward. This illustrates a close relationship between the 'social' and the 'cognitive' in group performance.

Focal group 2 (Sujatta, Alan, Nora/Barbara) working on problem B12

Figure 15. Problem B12



The pre-intervention test talk (Sujatta, Alan and Nora)

Nora:	Urr. What one?
Sujatta:	That one
Alan:	That one
Alan:	6 'cos its ...
Sujatta:	No wait.
Nora:	(inaudible)

Sujatta: Plain, circle, circle.
Alan: That one.
Nora: What number is it?
Alan: 4 (Nora rings number 4 as the answer for B12)
(Appendix D, p 29)

The post-intervention test talk (Sujatta, Alan and Barbara)

Barbara: Ok then OK B12.
Alan: B12.
Alan: I think number 6.
Sujatta: Yeh ,why, why?
Alan: Because that's a diamond and that a plain diamond.
Sujatta: If you take away the diamond bit its left with a plain square.
Alan: Oh yeh. All right number 5
Alan: That's B12
Barbara: OK (B rings number 5 as the answer to B12)
(Appendix D, p 35)

Commentary

In the pre-intervention test the utterances are shorter and less explicit in their reasoning than in the post-intervention test. The children also spoke more quietly and hesitantly than in the post test. Sujatta is generally respected in the class and is deferred to by the other children in both episodes. In both cases Alan first suggests an answer and then Sujatta offers a reasoned challenge to it and Sujatta's answer is accepted. However in the first case Alan does not give an explicit verbal reason and Succata's reason is also not fully articulated. In the post-intervention test Sujatta insists that Alan elaborates on his choice and then gives a clear reason herself for an alternative. In both cases the third member of the group was not evidently involved in the decision although Barbara can be seen nodding in agreement on the video-recording.

Observation indicated that in the pre-intervention test the children were more concerned with reaching agreement and moving on than they were with the critical discussion of alternatives. Although challenges were raised and reasons

were given this was not done with the confidence and explicitness of the post-intervention test talk.

Summary of the sociocultural discourse analysis

In each of these three examples it is possible to see how children who failed to solve a problem in the pre-intervention test managed to solve the same problem in the post-intervention test. Some of the reasons for the improvement in the group's ability to solve these problems are specific to each group and some are general. Factors specific to each group are:

1) Group 1 moved from being distracted to being more seriously engaged in the task.
2) Group 2 moved from excluding one member to including him.
3) Group 3 moved from a lack of confidence in shared reasoning to greater confidence.

Factors that are general across more than one group are:

4) A greater quantity of talk.
5) More explicit reasons being given.
6) More alternatives being considered and rejected before a decision is made.

All of these factors can be related to the ground rules of exploratory talk, as these were defined in Chapter 4 and coached in the intervention programme described in chapter 6. The single most evident difference between the pre- and post-intervention transcripts in all three of these examples is an increase in the quantity and the quality of exploratory talk.

While the examples show a clear connection between exploratory talk and improved problem solving, they do not necessarily demonstrate that this increase in exploratory talk resulted from the coaching programme. It could be argued that the examples above have been carefully chosen to illustrate a case and so do not demonstrate a difference between the pre- and post-intervention talk of the

children as a result of the EPIC. To overcome this possible objection, a computer-based text analysis was used to abstract and generalise apparently relevant linguistic features in the specific examples given in order to systematically explore the differences between the talk of the children in the pre-intervention test and the talk of the children in the post-intervention test.

Discourse analysis using computer-based text analysis

Abstracting utterances within groups

The main hypothesis being explored is that the exploratory talk coaching programme affected the quality of the talk of the children and produced talk more effective in solving the group reasoning tests. So far this hypothesis has been explored using statistics and using the close analysis of extracts of transcripts. To show that the relatively concrete and local analysis of the trancript extracts are related to the test scores it is necessary to show that features in the transcripts which contributed to the successful solution of test problems were generally more prevalent in the post-intervention test transcripts than in the pre-intervention test transcripts.

The computer program !Kwictex, described in chapter 7, was used to explore 'key words in context' (KWIC) both focusing on the pre- and post-intervention test transcripts of each group and across all the available transcripts. Words and features that appeared to be relevant to successful group problem solving, for example the use of question forms or the phrase "cos', were taken from each excerpt of successful problem solving talk and generalised across the pre- and post-intervention-test transcripts of that group. Using !Kwictex the cycle of hypothesis formation and testing can be very rapid. The contexts of the use of many key words and linguistic features were explored. The brief presentation that follows reproduces a part of this process of analysis for the reader. Context parameters of !Kwictex were set to each utterance or turn at talk.

Focal group 1's use of 'because/"cos'

Focal group 1 produced only one utterance about problem A11 in the pre-intervention test. This contained the word 'because' being used to link a reason to a claim. In the post-intervention test talk about the same question they produced 9 utterances, at least three of which explicitly offered reasons for claims. These three utterances used the words 'as', 'so' and "cos'. !Kwictex analysis showed that the use of 'as' and 'so' in this way was rare in the talk of focal group 1 but that the use of 'because' or "cos' was more common. The following two lists gives all the instances of the use of either "cos' or 'because' in the pre-intervention test talk of focal group 1 and in their post-intervention test talk.

Focal group 1 pre-intervention test use of "cos' or 'because'

Elaine:	It isn't **'cos** look that's a square
Graham:	No **'cos** look watch there all down there and they are all at the side and they are all up there
Elaine:	Wait wait wait its that one **'cos** look its them two and them two () and them two
John:	**'Cos** look that goes out like that -
Elaine:	**'Cos** look that goes in
John:	**'Cos** look that goes too far out
Graham:	Look **'cos** that's got 4
Elaine:	No .... not that one not that one **because** its got a little bit like that its that one look - it goes in and then it goes out
John:	No its isn't **because** its there
Elaine:	No **because** it will come along like that
Elaine:	Could be that one **because** look stops at the bottom and look
Elaine:	It isn't It isn't **because** look

(12)

Focal group 1 post-intervention test use of "cos' or 'because'

Graham:	Number 6 **'cos** 6 stops in there **'cos** look if you
Elaine:	It cant be there **'cos** look if you done that
Elaine:	It is look if that goes like that and then it has another one **'cos** those two make

Elaine:	He doesn't say what they are **'cos** he might be wrong
Graham:	Yeh **'cos** look
Elaine:	**'Cos** it would go round
John:	It is **'cos** it goes away **'cos** look that one goes like that
Elaine:	No it can't be **'cos** look ... with the square with the triangle you take away the triangle so you're left with the square so if you do just this and then again take that away it's going to end up, like that isn't it?
Graham:	Actually **'cos** that's got a square and a circle round it
John:	Yeh **'cos** it goes like that and then it takes that one away and does that
Elaine:	No **'cos** look
Elaine:	Probably one in the circle **'cos** there are only two circles
Graham:	**'Cos** if they are lines and then they are going like that it is **because** they are wonky isn't it
Graham:	No actually it ain't **'cos** then
Elaine:	Yeh its number 8 **because** those ones - those two came that those two make that
John:	No **because** 1, 2, 3 1, 2, 3
John:	No **because** that goes that way and that goes that way
Graham:	No **because** it's that one

(21)

Commentary. There were more uses of "cos' or 'because' to link reasons to claims in the post-intervention test then in the pre-intervention test with the same group of children. In the pre-intervention test two-thirds (8) of the usages are collocated with 'look' - that is either 'because look' or "cos look'. In the post-intervention test this collocation is less frequent. It occurs 6 times which is less than one third of the total uses. When collocated with 'look' because or 'cos' has a dietic function like non-verbal pointing. In this case the reason or warrant is outside of the talk. In these utterances there is a noticeable shift from using 'because/'cos' in this way to using it to link claims to verbally elaborated reasons which are more evident in the talk.

Focal group 2's use of questions

In the successful solution to problem E1 three questions are asked. These appear to be important to the establishing of intersubjectivity and the problem solution.

Pre-intervention test questions asked by focal group 2

Natalie:	Right so which one?
Natalie:	How can it be?
George:	How comes I'm not getting to do any of this?
George:	So which one is it? no 8?
Natalie:	What are we on?
Jane:	It's got to be that one 'cos look these are all them these are all them and these are all them - it's got to be that one huh?
Jane:	What are you on about?
Natalie:	Can you tell?
Jane:	No look that one's got a star in it, right? That one's just blank and that one's got ...so its got to be that one that's got a circle in it

Post-intervention test questions asked by focal group 2

Jane:	What do you think?
Jane:	Which do you think it is George?
Jane:	Why do you reckon its that one?
George:	Um. What do you think it is Natalie?
Natalie:	Do you agree?
Jane:	Now these are ... what do you think George?
Natalie:	Do you agree?
Jane:	I think its' that one - what do you think?
Jane:	Well I think it's this one - What do you think?
Jane:	What do you think George?
Jane:	That one what do you think Natalie?
Jane:	What do you think George?
George:	Yeh - what number?
Jane:	Why do you think that?
Jane:	What do you think it is George?
Jane:	So do you agree with that?
Jane:	Well why do you think that?
Jane:	What do you think George?
Jane:	Now look I think it's a square and a cross. What do you think?
Natalie:	Yeh George what do you think it is?
Jane:	Why do you think that?
Jane:	Do you agree its that?
Jane:	Why don't you think its any of them?
Jane:	What do you think George?
Jane:	What do you think George?

Natalie:	Who agrees with me?
Jane:	Well what do you think George?
Jane:	Well I reckon its something to do with this because there's three of them 3 of them so I think number 8. What do you think?
Natalie:	What about them lot and them lot?
Jane:	Do you agree George?
Natalie:	.Number 1 'cos if you add that and that and that and if you take the dots away it leaves you with that which leaves you that don't it?
Jane:	Right you think its no 1 - do you agree?

Commentary There are many more questions asked in the post-intervention test than in the pre-intervention test. Most of these seems to serve a function that is at least as much social and affective as it is cognitive. Asking if others agree shows respect for the group. It implies that claims are provisional and that the speaker is open to other views. Asking what specific others think draws them into the problem-solving process.

We can see from the transcript extract of group 2 solving problem E1 above that George's contribution was important. These questions show George's irritation at being excluded from the exercise in the pre-intervention test. 'How come I'm not getting to do any of this?' he asks. The post-intervention test shows the two girls, particularly Jane, frequently asking him for his view. In doing this the girls are implementing one of the ground rules coached in the exploratory talk coaching programme (see chapter 6). This list of questions taken with the transcript extract shows how ground rules of exploratory talk led to a more inclusive group which in turn led to a better problem solution.

There are many more challenges in the post-intervention test questions than in the pre-intervention test question asking the last speaker to elaborate and give reasons for their claim.

Focal group 3's use of 'Why ...?'

In the transcript excerpt of focal group 3 solving problem B12 the use of the simple question 'Why?' by Sujatta prompted an elaboration by Alan which in turn appeared to help Sujatta see the correct solution.

Pre-intervention test use of 'Why ...?' by focal group 3

Sujatta:	Why did you do that - did you just put 7?

Post-intervention test use of 'Why...?' by focal group 3

Sujatta:	Why do you think it?
Alan:	Why?
Sujatta:	Yeh why why?
Alan:	Yeh why do you think that one?
Sujatta:	Wait Right Barbara why do you think it is that one?
Sujatta:	Wait wait wait Barbara why do you think it is?
Sujatta:	Why do you think its number 4?

Commentary

'Why' used to mean 'why do you think that?' was not a significant linguistic feature of the talk of the children in the pre-intervention test. The one use of why was directed towards an action 'Why did you do that?' rather than towards an idea. The form 'Why do you think that?' only appears in the post-intervention test. This was a form explicitly coached in the EPIC.

Summary

These abstracted utterances show how, for each group, types of utterance that were found to be successful in the full transcript analysis of group problem solving are found more in the post-intervention test than in the pre-intervention test.

Abstracting linguistic features for all the data

In Chapter 3 the use of key usage counts was introduced. A key usage is not simply a key word but a key word being use to serve a particular function. The use of !Kwictex to look at a word in its immediate context facilitates the ascribing of a function to that word. In the context of the pre- and post-intervention group reasoning tests the following list of key usages were indicative of exploratory talk:

'if' used to link a reason to an assertion

'so' used to link a reason to an assertion

'because/'cos' used to link a reason to an assertion

Any question used to support debate, including challenging 'why' questions, and more socially inclusive 'what do you think?' and 'do you agree?' questions.

Table 8 shows counts of these key usages for the talk of the three focal groups when doing the standard group test together.

Table 8. Key usage count for the pre- and post-intervention tests of the focal groups

	Pre-test				Post test			
	Gp1	Gp2	Gp3	*Total*	Gp1	Gp2	Gp3	*Total*
Test score	**15**	**18**	**19**		**23**	**22**	**22**	
Questions	2	8	*7*	*17*	9	33	44	*86*
Because/'Cos	12	18	9	*39*	21	34	40	*95*
So	6	3	1	*10*	6	5	*7*	*18*
If	1	1	0	2	13	8	14	*35*
Total words	1460	1309	715		2166	1575	2120	

Summary

Computer-based text analysis using !Kwictex demonstrates a difference between the post-intervention test talk of the three focal groups and their pre-intervention test talk. This difference takes the form of more talk more reason clauses using the linguistic forms 'because/'cos'', 'so' and 'if' and more questions being asked.

8.6 Discussion

In this discussion the three aspects of the results of this study will be brought together. The statistical results from the test-score results offers evidence that the EPIC had a positive effect on group test-score results. However, taken alone, this evidence does not show the cause of this apparent relation. The sociocultural discourse analysis of the talk of three focal groups working on problems that they fail to solve in the pre-intervention test but succeed in solving in the post-intervention test provides evidence that exploratory talk helps group problem solving. However, taken alone, this evidence might be open to the criticism that it is too small a sample on which to base a sound judgement. The computer-based text analysis enables a relationship to be made between the abstract results of the test-scores and the three concrete cases studies. It shows that key features of the talk of the children in successful problem-solving were generally found in greater quantity in the post-intervention test than in the pre-intervention test.

The section on 'aims' at the beginning of this chapter put forward three hypotheses for investigation. The first of these was that the amount of exploratory talk produced by groups in collaborative work would increase as a result of the EPIC. The two discourse analysis sections support this hypothesis by showing an increased use of exploratory style of talking together between working on problems in the pre-intervention test and working on the same problems in the post-intervention test.

The second hypothesis was that an increase in exploratory talk would lead to increased scores in group reasoning tests. The improved group test-scores over the periods of the EPIC suggest this effect. However the control class group test scores also improved, albeit less markedly, so it is not necessarily evident from the figures alone that the improvement resulted from the increased use of exploratory talk. This is where the more context-sensitive discourse analysis augments understanding of the significance of the statistics. The detailed sociocultural discourse analysis of three problems which were not solved in the pre-intervention test but were solved in the post-intervention test shows how the exploratory talk strategies coached in the EPIC helped produce a better solution.

The third hypothesis was that coaching exploratory talk would lead to some individuals increasing their scores. The statistical evidence supported this hypothesis. Some individuals in the target class increased their scores markedly; others did not.

The third hypothesis was of interest because of the Vygotskian idea that some of the strategies which led to improved group problem-solving would be in some way 'internalised' to help with individual problem-solving. However this effect was only anticipated for those children who responded to the exploratory talk coaching. It is evident from the transcripts of the three focal groups that not all the children responded equally to the coaching programme. For example in group 1, John fights throughout for an individualistic interpretation of the task while Elaine and Graham try to impose the ground rules of exploratory talk. It is relevant that both Elaine's and Graham's score on the individual reasoning test increased while that of John remained the same. The teacher believed that ten children did not respond very significantly to the coaching programme. There may have been varying reasons for this, including, in some cases, frequent absences. If the scores of these children were removed the statistical results for individual reasoning test scores would show an even more convincing increase. It

is noticeable that the largest increases occur with those individuals who initially got the lowest scores. The data collected does not offer clear evidence as to why this was. One possible explanation which would follow from a Vygotskian view of development is that simple strategies such as questioning oneself before deciding on the answer had already been internalised and were being used by the higher scoring children but were internalised in the course of the intervention programme by some of the initially lower scoring children.

8.7 Summary and conclusion

This chapter has looked at the results of the evaluation of the EPIC that relate both to its role in coaching exploratory talk and to the effect of increased exploratory talk on traditional tests of general reasoning. The evidence shows convincingly that both the quantity and the quality of exploratory talk produced by groups of children working on a standard task increased as a result of the EPIC. The evidence is also convincing in demonstrating a link between the group use of exploratory talk and results on a group reasoning test. This was achieved through an evaluation design that enabled the quantitative scores on the reasoning test to be related to qualitative changes in the talk of the children. The evidence that this group improvement in ability to do reasoning tests transferred to individuals working alone has to rest on statistical analysis alone. These show a significant result. If contextual factors such as the differential response to the exploratory talk coaching by the children were also taken into account, the evidence of a link between coaching exploratory talk and individual reasoning test score would be even stronger.

The role of the computers and the talk of the children around the computer was not looked at in this chapter and will be the subject of the next chapter. The evidence presented here indicates that the EPIC successfully coached exploratory talk and that the increased use of exploratory talk led to improved problem solving. This is relevant to an analysis of the role of computers both within the

EPIC as a support for the coaching programme and as a support for exploratory talk within curriculum exercises.

Chapter 9 Evaluation of the EPIC: The role of the computer

9.1 Introduction

This chapter continues the evaluation of the EPIC begun in chapter 8. It focuses on the role served by the use of computers in the EPIC.

As with chapter 8 the evaluation is structured like an experimental report with sections on aims, method, results and discussion. This presentation format does not always fit comfortably with the research it describes. Where transcript extracts are presented the pattern established in chapter 8 is followed. An initial commentary remaining close to the text is given in the results section and the significance of the talk and commentary is drawn out further in the discussion section.

The discussion section draws on some of the results described in chapter 8 as well as results described in this chapter in order to assess the significance of the role of the computer-based work in the EPIC as a whole.

9.2 Aims

Analysis of the talk of the children working at the specially designed computer software was intended to explore the following three hypotheses:

- That the quality of children's interactions when working together at computers can be improved by coaching exploratory talk.
- That computers can be used effectively to support the teaching and learning of exploratory talk.

- That computer supported collaborative learning can serve to integrate peer learning with directed teaching.

These hypotheses emerged from the exploratory research described in the first part of the thesis, particularly chapter 5. The first hypothesis focuses on the effect of the off-computer coaching of exploratory talk on work at the computer. The second hypothesis reverses this perspective to look at the role of computer-based work in supporting and extending the coaching of exploratory talk. The third hypothesis refers to the educational role of the computer as a support for exploratory talk directed towards curriculum ends.

9.3 Method

Subjects and procedure

The target class was described in chapter 8. After a seven week exploratory talk coaching programme this class were given two items of computer software specially developed for the programme. Details of the coaching programme and the software were outlined in chapter 6. As far as possible the children worked on the software in the same groups of three that they had been in throughout the programme. The citizenship software took about 15 minutes to run through once and sessions with the science software were variable. All lasted at least 20 minutes. Some were terminated after an hour.

Systematic comparisons

A neighbouring class of year 5 children were given the citizenship software to use in groups of three. Two groups from this class were given the science software and videotaped using both items of software. These groups were said by the teacher to be representative of the range of ability and motivation in the class.

Two groups from the target class did not use the software at the same time as the other children. Instead they were given off-computer group tasks with a similar educational aim. Their work at these tasks was videotaped.

The off-computer citizenship exercise was based on a paper version of the computer software with dynamic links replaced by directions to go to different pages.

The science exercise was a normal science lesson with similar objectives in the area of experimental method but using an experiment with different kinds of glue and materials rather than with the variable involved in flower growth. This lesson was conducted in a separate room with the main class teacher working with two groups of three children.

Recording and transcription

The three target class focal groups introduced in chapter 8 were videotaped using the science software. One of these groups and two further target class groups were videotaped using the citizenship software.

Transcriptions were taken of all the pupil-pupil talk in the videotaped citizenship activities that was not read from the screen or page. Transcriptions were taken of the pupil-pupil talk in the first twenty minutes of all the videotaped science activities.

These transcriptions are given in full in Appendix E. As with the transcriptions in chapter 5 quantitative analyses of key usages in these transcripts were based on peer-peer talk only.

Discourse analysis

The same methods of discourse analysis were employed as those used in chapter 8 – a combination of sociocultural discourse analysis and computer-based text analysis.

Computer-based recording

The amount of time children spent at each screen before making a choice was recorded automatically by the software, as were the choices made and, in the case of the science software, the variables they selected.

Structured pre- and post-intervention interviews

Immediately before and immediately after the sessions with each item of software all target class groups and two control class groups were asked some simple questions and notes were taken of their responses. These questions were:

For the citizenship software:

1a) Is stealing wrong? 1b) If so why? Is it always wrong?

2a) If you promise your friend to keep a secret should you keep that promise? 2b) If so why? Always?

For the science software:

1) What do plants need to help them grow?

2) You have all baked bread recently. If you were being scientific how would you find out how to bake the best bread?

In the light of the curriculum teaching aims discussed and justified in Chapter 6, these answers were assessed for a positive pre- to post-intervention shift as follows:

- For the first question in the citizenship exercise a positive shift was moving from self-centred answers e.g. 'I'll get into trouble' (Kohlberg's stage one) to answers showing awareness of the victim's perspective and the perspective of society

as a whole, e.g. 'I wouldn't like it if someone stole something from me' or 'if everybody stole things then there wouldn't be things to buy'.

- For the second question on the citizenship exercise a positive shift was marked for answers giving one point of view without qualifications to answers giving reasoned qualifications.

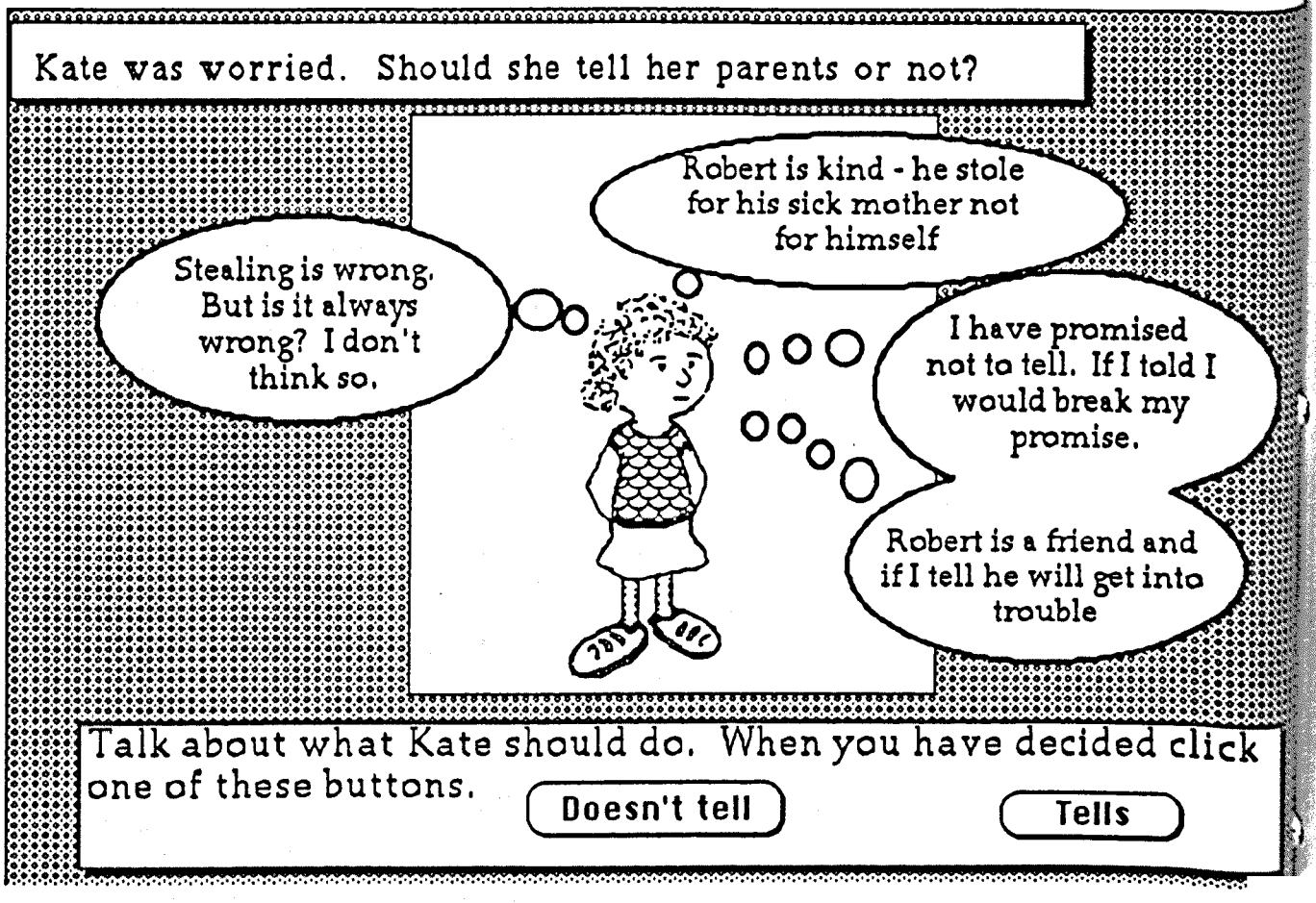
- For the first question on the science exercise the positive shift looked for was from suggesting the sun as a factor in plant growth to separating out the two 'scientific' terms 'light' and 'temperature'.

- For the second question on the science exercise a positive shift was either from not knowing how to investigate a problem to suggesting doing many 'tests' or from suggesting doing many tests to talking about doing 'fair tests' in which only one variable was changed at a time while the others were kept constant.

9.4 Results from the citizenship software

The following analysis will focus on the talk of children at the first decision point of the 'Kate's Choice' software. The reason for choosing this one decision point is that it enables a generalisation to be made to all the groups in both the target and the control class. It was the only decision point which all groups had to do which had a fixed amount of text to read. Given that, according to the class teachers, the two classes were of equivalent overall reading ability and given that all the children observed were highly motivated by the software it follows that the different amount of time taken up in making this decision can offer some indication of how much time was spent talking to each other. This then enables a systematic comparison to be made of the interactions of the groups in the three conditions.

Figure 16. Kate's first choice



Talk of the target groups

Three groups of children were videotaped using this software. The talk of these groups at the first decision point of Kate's Choice (figure 16) was transcribed. These three episodes are presented in full below with short commentaries.

1) Natalie, Jane and George

(Natalie reads from the screen)

Jane:	Right we'll talk about it now.
Natalie:	Ssh (reads) 'talk about what Kate should do. When you have decided click on one of the buttons'.
Jane:	Well what do you think ?
George:	Doesn't tell.
Jane:	What do you think Natalie?
Natalie:	Well I think she should tell because its wrong to steal - but it's her friend.

Jane/George: It's her friend.
Natalie: It's her friend as well.
George: He knows it's wrong.
Natalie: Yes but he's not doing it for her, er, for him, he's doing it for his mother. So I reckon she doesn't tell.
Jane: Yes, I agree.
George: Agreed, agreed.
Natalie: Doesn't tell then? One, two, three - (Clicks)
George: Here we go, here we go.
Jane: (reads) 'Have you all talked about it?'.
All: Yes.
Natalie: (Clicks)
(Appendix E, p 3)

(Total time on the card: 97 seconds.)

Commentary. These children respond immediately to the cue on the screen which says 'Talk about what Kate should do'. They obviously know what this means and they sit back from the screen a little and turn to look at each other. Jane takes on a discussion facilitator's role asking the others what they think. Through this everyone is involved. Reasons are given taken from the list of reasons on the screen. Both Natalie and George give reasons against their original positions. Natalie appears to change her view. Jane takes on a facilitating role asking questions and encouraging a consensus. All children reach agreement before the mouse is clicked.

According to the description of exploratory talk put forward in Chapter 4 this talk is clearly exploratory. Reasons for assertions are given and questioned within a cooperative orientation.

2) Barbara, Martin and Ross.

(Barbara reads aloud from the screen)
Ross: I think he should not - he shouldn't tell.
Martin: Don't tell.
Ross: (Reads) 'Talk about what Kate should do ...'

Ross: I think she shouldn't tell because she said she'd promise.
Martin: Yeh, if she broke her promise he'd be into trouble right? Broke her promise he'd be into trouble.
Barbara: Yeh, but on the other hand...?
Ross: Yeh and he did do it not for himself but for his mum and his mum's sick.
Martin: No, but he could be lying.
(3 second pause)
Barbara: Yeh, but would you do it? - would you tell?
Ross: Umm, no. If I did I'd feel guilty.
Martin: I wouldn't.
Barbara: (Clicks and then reads) 'Have you talked about it?'
ALL: Yes.
(Appendix E, p 1)

(Total time on the card: 82 seconds.)

Commentary. Here Barbara takes on a facilitating role asking questions and putting forward alternatives. She challenges the sincerity of the others asking them if they would really do what they are saying Kate should do. Nobody argues in favour of telling but Michael suggests that they should be cautious in believing Robert's story. They all reach agreement before the mouse is clicked.

Again the talk is exploratory with children raising and criticising a range of reasons for both alternatives before reaching a shared decision.

3) Adrian and Sally

(Read text together taking a sentence each)
Sally: So what do you think? 'Cos is it bad stealing do you think?
Adrian: No 'cos he was doing it for his mum.
Sally: But I think that's stupid as he could always get some money couldn't he?
Adrian: No.
Sally: Even off his grandparents or something?
Adrian: No, but his grandparents might of died mightn't they?
Sally: Oh yeh.
Sally: So we go for yes yeh? She tells. No, er, doesn't tell.
Adrian: Doesn't tell.
Sally: (Clicks then reads) 'Have you all talked about it?'

Both: Yes.

(Total time on the card: 102 seconds.)

Commentary. Here Sally and Adrian disagree. Adrian offers a reason for his view. Sally challenges the validity of the reason, offering a counter argument. Adrian refutes the counter argument. Sally is persuaded. Both reach agreement before the button is clicked.

Again this talk is exploratory. In it we can see a development over time in which Adrian is forced to elaborate his view and Sally, after raising objections, comes to agree with him. She apparently expands her moral perspective to take into account children with different circumstances from herself – in this case children without grandparents who will give them money when they ask for it.

Talk of the uncoached groups

Children of the same age in a neighbouring class to the target class who had not had any of the exploratory talk coaching lessons were asked to use the citizenship software. These groups were treated in exactly the same way as the target class groups. They were asked to talk together while using the software. Two groups said by the teacher to be representative of the range of ability and motivation in their class were video-taped and transcripts made of their talk at the first decision point of Kate's Choice.

1) Mary, Cathy, Brian

(Cathy reads from the screen)

Mary: Doesn't tell or tells? What should we do? Does she tell or doesn't she?

Cathy: We've got to guess.

Brian: Tells (in a loud and authoritative voice).

Mary: Tells (Clicks).

Cathy: (Reads from screen) 'Do you all agree?'

Brian: Yes (again in a loud and authoritative voice).

Cathy: Yes.

(Appendix E, p 5)

(Total time on the card: 48 seconds.)

Commentary. The group do not know what to do despite the cue on the screen to 'Talk about what Kate should do' and the teacher's prompt before they use the software suggesting that they should talk together. Cathy says 'We've got to guess' implying perhaps that she thinks that there is a right answer and that they have to just guess which of the two it is. The one boy in the group decides for everyone with a single authoritative exclamation. No reason is given for his decision. No one questions it.

2) Jim, Tony, Susan

(All three read screen together)

Jim:	(Reads) 'Talk about what Kate should do then click on one of the buttons.'
Tony:	What should we do?
Jim:	Do that.
Tony:	(Turning to call the teacher) Excuse me. (Turning back to others) We don't know what to do.
Susan:	(Clicks)
Jim:	Yes we do.
Susan:	(Reads) 'Do you all agree?'. Should we tell?
All:	Yes.

(Appenidx E, p 8)

Total time on the card: 62 seconds.

Commentary. Here again the children are uncertain as to what to do. The cue 'Talk about what Kate should do' means nothing to them. Although Jim reads it out and says that they should just 'do that' he does not in fact try to discuss the issues. Susan, in control of the mouse, takes the decision for the group by clicking it without asking anyone or getting agreement. Nobody protests.

Summary of the transcript evidence

The following features were exhibited in the talk of most of the target class groups observed:

- Asking each other task-focused questions.
- Giving reasons for statements and challenges.
- Considering more than one possible position.
- Drawing opinions from all in the group.
- Reaching agreement before acting.

These five features were all explicitly coached in the intervention programme as ground rules for talking together. These features were found less or not at all in the talk of the control class groups. Most control class groups observed moved forward through the story in one of the following ways:

- Unilateral action by the child with the mouse.
- Accepting the choice of the most dominant child without supporting reasons.
- Drifting together to one or other choice without debating any alternatives.

The impact of the coaching lessons could also be seen in the response of the children to the simple cues put up on the screen to 'talk about what Kate should do'. The control groups were baffled and did not know how to proceed. The target groups clearly knew what to do. In the two cases illustrated they sat back a little from the screen and looked at each other ready to discuss the issue.

All three transcript extracts from the target class show children engaged in exploratory talk in which reasons are both offered and questioned and an agreement is worked out cooperatively before a decision is taken (see definition of

exploratory talk in chapter 4). Several children change their initial position in the course of discussion. The style of talking together is similar to that reported in chapter 8 for the talk of target class groups on the final group reasoning test. The content of the talk is however related to the citizenship curriculum and the children appear to be developing their understanding in this area.

Computer-based text analysis

The difference between the pre- and the post-intervention test talk for the EPIC as a whole was shown in chapter 8 to be quantifiable through the marked increase in the number of task-based questions asked and the uses of the key terms 'if' and 'because/'cos' to link reason clauses to assertions. Applying the same 'key usage' analysis to the full transcripts of two target (coached) groups and two control (uncoached) groups working on the citizenship software produces the results shown in Table 9. (These transcripts are given in full in Appendix E.1 and E.2)

Table 9. Key usage count for target and uncoached control groups.

	Control	Target
Questions	4	13
Because/'Cos	0	7
If	0	2
Total words	496	942

This table reveals a marked difference between the talk of the children coached in exploratory talk and that of the children who had no coaching. To observe the relationship between the coaching programme and the language used it is necessary to look at the actual words in context that lie behind these figures. The following list of questions used was obtained by setting the context parameters of !Kwictex to that of the relevant utterance or turn at talk.

Questions asked by the target groups

1) Natalie, Jane and George

Natalie:	Doesn't tell then? One, two, three -
Jane:	'I don't know'. yes?
Jane:	You all agree?
Natalie:	(reads) 'Have you all talked about it?'. Yes?
Jane:	So do we all agree?
Natalie:	No, look. What do you think?
Jane:	I say she done right. Right what do you think? Do you agree?
Natalie:	Right so what do you think?(sitting back on chair). Should he give the chocolates back or what?
Natalie:	Why do you think that George?
Jane:	Do you agree then?

2) Martin, Barbara and Ross

Martin:	Yeh, if she broke her promise he'd be into trouble right? Broke her promise he'd be into trouble.
Barbara:	Yeh, but on the other hand...?
Barbara:	Yeh, but would you do it? - would you tell?
Martin:	I don't know - yes?
Martin:	Yes?
Barbara:	So what do you think?
Barbara:	Why do you think that?
Ross:	Yeh - what do you think? (to Martin)

Questions asked by the control groups

1) Mary, Cathy, Brian

Mary:	Where's the answer (reads) 'Doesn't tell, tells'. Does she tell? What should we do?
Mary:	What do you want?

2) Jim, Tony and Susan

Tony:	What should we do?
Susan:	(Reads) 'Do you all agree?'. Should we tell?

Commentary. The questions of the target class show the effect of the coaching programme. Asking peers what they think, why they think it and if they agree are all points emphasised in the coaching programme. Analysis of the full transcript shows that these questions occurred in extended sequences of exploratory talk like those illustrated in the transcript extracts. The full transcript (Appendix E.2) shows that the uncoached control group, did not engage in any sequences of exploratory talk.

Quantitative analysis using data-capture

The transcript evidence presented above shows the target groups taking longer than the control groups at the decision point because they are engaged in reasoning together about the decision which they then take jointly. All the children in both the classes used this software in small groups, mostly groups of three but occasionally in pairs, and the amount of time they took for this decision was recorded automatically by the software. The results are presented below.

Table 10. Time in seconds spent on the first decision point of Kate's Choice for all groups from both target and control classes

	Target class groups	Control class groups
	43	21
	63	35
	65	41
	67	48*
	74	51
	82*	58
	97*	59
	102*	60
	105	62*
Mean	77.55	48.33
S D	20.72	13.76

(* = focal group.)

Statistical analysis of these figures shows them to be highly significant ($p = 0.0015$. One-tailed T-test).

Since a proportion of the time spent at this card was spent reading the text the real difference in the time spent talking together between the target and the control classes is greater than that indicated by the figures.

Comparison with off-computer groups

Two groups from the target class who had been coached in exploratory talk were given a paper version of the citizenship software (Appendix E.5). Here are transcripts of the two groups at the first decision point in Kate's Choice. The main picture the children work with is the same as that in fig 16. They were asked to talk together while working through the booklet and given a piece of paper to make notes on Robert's punishment.

1) Barbara and Alan

Alan:	So what do you think she should do?
Barbara:	I don't know.
	(pause)
Alan:	What are we going to write about then?
Barbara:	Let's just have a look at 9.
	(turns pages and reads) 'You wouldn't lie to me would you ..'
	Let's look at 15.
	(reads) 'So Robert stole the chocolates'.
	Let's go to page 13.

(Appendix E, p 26)

Commentary. Instead of discussing the options the two children look ahead. They end up flicking rapidly through the booklet, pausing only to discuss Robert's punishment at the end.

2) Sharon and Martin

Sharon:	(reads page)
Sharon:	Do you think she should not tell or should she tell?

Martin: (shrugs) Go to tell then.
(Appenidix E, p 27)

Commentary. Sharon was keen to follow the ground rules that had been taught. Martin looked bored and refused to respond to her prompt. Later in the same exercise he did respond and this pair produced some high quality exploratory talk.

Computer-based text analysis (Comparing on-computer and off-computer talk)

Full transcripts were taken of the two groups (pairs) who worked off computer. These were analysed using three key usages which emerged in chapter 5 and chapter 8 as indicative of exploratory talk . The results of this are in Table 11.

Table 11. Key usage count for target and off-computer groups.

	Off-computer	Target
Questions	14	13
Because/'Cos	5	7
If	1	2
Total words	599	942

This table shows little difference between the two conditions of coached children. However, as we have already seen, there was a marked difference in the way they approached the first decision point in Kate.

From the full transcripts (Appendix E.5) it is evident that most of these key usages came from Sharon and Martin. Looking at the questions in the context of utterances reveals this imbalance between the two groups and helps to explore it further.

1) Barbara and Alan

Alan: So what do you think she should do?
Alan: What are we going to write about then?

Barbara: What is his punishment do you think?
Barbara: He should be watched when he goes into the shop?
Barbara: Work for Mrs Cooke yeh?
(Appenidx E, p 26)

2) Sharon and Martin

Sharon: Do you think she should not tell or should she tell?
Sharon: He stole them, yeh?
Martin: Yeh?
Sharon: What do you think? Do you think he should give the chocolates back? Work for Mrs Cooke? Give the chocolates back or not be punished?
Sharon: Why do you think that?
Martin: Why?
Sharon: What do you think do that or do that?(pointing at options)
Sharon: Why do you think that?
Sharon: Do you know why he stole from her?
Sharon: Martin why do you think he should work?
(Appendix E, p 27)

Commentary. The exploratory talk that breaks out between Sharon and Martin is prompted by Sharon's use of questions in the form 'what do you think?' followed by 'Why do you think that?'. This use of language was explicitly coached in the programme. From looking at the full transcripts (Appendix E.5) it is possible to see that exploratory talk does not break out for Barbara and Alan. They engage in cumulative talk in which questions are asked to co-ordinate their actions together rather than to challenge propositions.

Videotape observation

A number of relevant features of the interaction of the children are apparent on the video-tapes but are not picked up in the transcripts.

1) At the second decision point they reach in the citizenship exercise Martin tries to turn over the paper to go to the next link and Sharon physically prevents him until they have discussed and agreed a decision.

2) One part of the citizenship exercise asks users to read the views of the participants in the story by clicking on pictures of them. This was translated in the paper version to a series of pictures of characters with text attached. The interactive computer version proved highly motivating for all users. This could be seen by physical posture and eye focus (see Issroff, 1995, for a discussion on assessing motivation). However in the paper version the partner who was not reading looked bored and disengaged. In one case the partner not doing the reading began a conversation with other children in the room.

3) A difference in motivation between the groups working on the software and groups working on the paper version was evident throughout and was particularly marked at the beginning of the exercise. (Motivation was assessed through body posture, eye-movements and tone of voice.)

Evidence from the pre- and post-intervention interviews

The first question was about stealing. Three target class groups moved from simply saying that stealing was wrong because it got you into trouble to mentioning the moral issue of 'fairness' and the effect on society of stealing ('there wouldn't be enough things left'). The other groups mentioned the consequences of stealing for those stolen from in the pre-intervention test and so could not shift positively in the post-intervention test. This indicated a weakness in the design of the interview questions.

No groups showed a significant shift on the second question which was about keeping promises because all groups, both target and controls, discussed this issue well in the pre-intervention test.

9.5 Results from the science software

Talk of the target groups

1) Gail, Graham and Elaine using Fred's Flower

Gail:	What shall we change? Water, light or temperature?
Graham:	Water.
Elaine:	Temperature.
Elaine:	I think they need light more than they need temperature.
Gail:	I think they need a lot of light.
Elaine:	So take down temperature.
Graham:	We should take it to 2.
Elaine:	Yes.
Graham:	Right.
Elaine:	Grow, grow (Computer puts up prediction card shown in figure 1).
Gail:	Same as last time?
Elaine:	No shorter than last time.
Graham:	Yeh because you put down the temperature.
Elaine:	Right, let's next time do it the same.

(Appendix E, p 13)

Commentary. In this extract the children discuss the needs of plants for water, light and temperature, ask questions, make predictions and plan fair tests. The computer's dynamic prompt asking them to make a prediction on the basis of the results of previous tests (Figure 6) plays a key role in encouraging them to discuss how their changes in the variable settings will affect plant growth and leads them to plan future experiments.

2) Natalie, Jane and George

Jane:	'We think the flower will grow'... 'taller than last time'
Jane:	'the same as last time'
Natalie:	No, because it died last time didn't it?
Jane:	oh yes
Jane:	It's growing, it's growing
George	It's growing
Jane:	49 centimetres! Try it again.
Natalie:	Shall we give it a bit more water?

George (inaudible)
Natalie: No it's not going to grow anymore. Give it 2 water.
(Appendix E, p 15)

Commentary. Here the group set the variables and are prompted by the computer to make a prediction. They work cooperatively using questions to share ideas and giving reasoned challenges. This talk is exploratory but without the kinds of extended exploratory exchanges produced by the same group in both the group reasoning post-intervention test and talk around the citizenship software.

Comparison with uncoached class

Because the science software was a more complex piece of software than the citizenship software it is not possible to use the strategy used for the citizenship software of comparing talk and time taken at a particular point in the programme.

The first 20 minutes talk of two groups in the target class was transcribed and compared to the first 20 minutes talk of two groups in the uncoached control class. These groups were selected by the teachers involved as typical of the range of ability and motivation in their classes. Applying the same 'key usage' analysis as was applied in chapter 8 and above to the results of the citizenship software produced the following table.

Table 12. Key usage count for target and uncoached groups.

	Uncoached control	Target
Questions	15	30
Because/'Cos	4	6
If	2	2
Total words	1211	1640

This table shows that twice as many task-focused questions were asked in the same period of time by the coached target class groups than by the uncoached control class groups.

To see if there is any link between this difference in the talk of the two groups and the coaching programme it is necessary to focus in on the actual questions asked. One way to explore this is by looking for the kind of questions coached in the coaching programme. These were open questions beginning with 'why or 'what'. Examples of questions suggested in the coaching programme are 'What do you think?' and 'Why do you think that?'. The following lists shows all the questions beginning with 'why' or 'what' used by the target groups and by the uncoached control.

'Why' and 'what' questions asked by target group

1) Elaine, Graham and Gail

Elaine:	Now what do we do? Press start
Graham:	What kind of plan do we need?
Elaine:	Now what do we do now?
Elaine:	OK now what should we try?
Elaine:	I told you it'd be taller Now what did we do wrong?
Elaine:	What do you think we've done wrong?
Elaine:	What does it need most?
Graham:	What shall we change? Water Light or Temperature?
Graham:	What do we do now?

2) Jane, Natalie and George

Natalie:	What we got to do?
Natalie:	What do we do now?

'Why' and 'what' questions asked by no coaching control groups

1) Mary, Cathy, Brian

Cathy:	Right height 'h' 'e' - no what do we have to do?
Cathy:	What did you press?
Cathy:	What do I do past tests?

2) Susan, Jim, Tony

Jim:	Temp 1. What do I do? Put tests?

Commentary. One of the target groups asked many more questions with 'what' than the uncoached controls. Most of these were open and reflective questions of the type encouraged in the coaching programme.

Comparison with off-computer groups

The off-computer science activity video-recorded was a very different kind of educational activity from the science software. It was not about plant growth but about glue strengths using different materials and it was activity based. In comparing the talk of the children we are not comparing like with like. Nonetheless the first 20 minutes talk of both the groups were recorded and transcribed (Appendix E.6). As before the occurrence of key usages in the peer-peer talk was measured to produce the following table.

Table 13. Key usage count for target and off-computer groups.

	Off-computer control	Target
Questions	11	30
Because/'Cos	4	6
If	3	2
Total words	1456	1840

The off-computer groups evidently asked less task focused questions of each other than the on-computer groups. However the questions that they did ask all occurred in the first five minutes when they were asked to plan together how they would test the effectiveness of different glues at sticking different materials. After this successful planning period the teacher talked to each group in turn to discuss their plans and lead them towards the idea of a fair test before asking them to carry out their plans.

Off-task talk and behaviour

After the initial planning phase the children got on with the practical business of conducting the experiment. This involved much activity, getting materials from different parts of the classroom, cutting them and sticking them together in various ways. This activity seemed engaging but did not lead to much science talk. In one group there was a great deal of off-task talk. In the following illustrative transcript Laura and Alan are both sitting side by side cutting up bits of paper when Laura turns to Alan to ask him a question:

Laura: Guess what?

Alan: What?

Laura: I have got a childminder now. My sister goes to work and my mum has to go to work as well - every other week I have the childminder. 'Cos my mum starts 6 to 3 on one week sometimes she does floating which means she starts after I come to school and my sister's got a job from half past 3 till ten down the city for a cleaner ...

(Appendix E, p 33)

While the actions of these children were on-task their talk was not. This compares markedly with the much more focused atmosphere of the computer-based work in which extended social talk of this kind simply did not occur.

The materials used seemed to fascinate the children and provided many opportunities for distraction. Despite the presence of two adults in the room with only six children the video shows boys hitting girls with large cardboard rolls on two separate occasions and a fight at the sink over a plastic bottle.

Procedural talk

In the active phase of the lesson the talk of the children which was not off-task was mostly of a procedural nature such as 'Pass the scissors' or 'That's mine, get off'.

Teacher's role

Children worked happily at Fred's Flower for long periods - up to one hour - without intervention from a teacher. The teacher was asked for once by each of the groups doing Fred's flower to explain the early instructions. In the off-computer activity the teacher intervened more often. This was partly because she was in the fortunate position of having only six children to deal with, but it was also because the nature of the activity called for more direction from a teacher. At the end of the first phase the teacher needed to check the plans of the children. On several further occasions the teacher was called over by the children with questions such as: 'Miss, what should we do now?' And: 'Miss, can we cut the leather?'. Clearing up the mess at the end of the lesson also called for a considerable amount of direction from the teacher.

Evidence from the pre- and post-intervention interviews

Seven target groups and two uncoached control groups were asked two simple questions immediately before and immediately after using the software. These questions were assessed for a positive shift.

For the first question 6 target class groups made a positive shift from mentioning that plants need 'sun' amongst other things to mentioning that plants need 'temperature' and 'light' amongst other things. One target group did not make this shift. The two uncoached control classes did not make this positive shift.

For the second question the two uncoached control classes made a positive shift from not having an answer as to how to investigate a problem to saying 'do some tests'. The on-computer target groups all began with the idea of doing some tests but did not move on to the desired idea of doing fair tests changing one variable at a time. One off-computer target group did make the shift in the post-intervention

test to the idea of gradually changing one variable while keeping the others constant.

9.6 Discussion

The aim of this evaluation was to explore three hypotheses. These hypotheses will be used to structure the discussion.

> **Hypothesis 1: That the quality of children's interactions when working together at computers can be improved by coaching exploratory talk.**

Evidence for this hypothesis was gathered through a comparison between the talk of the target class children who had been coached in exploratory talk and that of a neighbouring class of same age children who had not been coached in exploratory talk. Comparison of transcript extracts from the talk of children at a single decision point in the citizenship software suggested a marked difference in the quality of talk. The talk of the target class groups showed extended discussion with challenges being offered, reasons being given for assertions and agreement being reached before any decision was taken. The talk of the uncoached control groups was educationally disappointing and demonstrated that the uncoached groups of children did not know how to collaborate together effectively.

It might be claimed that these extracts were not typical of all the talk at the software produced by these groups but were selected to make a point. To investigate this possibility all the talk of the two target class groups who were video-taped and of the two groups from the uncoached control class who were videotaped was transcribed and analysed using computer-based techniques. This analysis used counts of key usages indicative of exploratory talk and also the presentation of the same key usages in the context of full utterances to demonstrate that the exploratory pattern of talk found in the target group extracts continued throughout the time the target groups spent on this software. The

uncoached control class groups, on the other hand, produced far fewer key usages associated with exploratory talk.

The groups videotaped were said by the respective class teachers to be typical of the range of ability and motivation in their classes. Despite this it might be claimed that they were actually exceptional and chosen to support the hypothesis. To explore this possibility a comparison of the performance of all the groups in the target class with all the groups in the uncoached control class was undertaken. This comparison showed that the target class groups spent significantly longer at the first decision point in the citizenship software than groups from the no-coaching control class. The transcripts of the groups from each condition who had been videotaped indicated that this extra amount of time was related to the amount of exploratory talk they engaged in.

The science software appears to have been less successful than the citizenship software in supporting sustained exploratory exchanges. The transcript evidence suggests that the eagerness of the children to try out different combinations of variables and watch the flower growing over-rode some of the devices built into the software to slow them down and encourage them to reflect.

Nonetheless what evidence there was supported the case made with respect to the work at the citizenship software. In the first 20 minutes the focal groups in the target class asked twice as many questions as focal groups in the uncoached control class. Analysis of the questions asked by the target class groups showed that they reflected the style of questioning coached in the preceding off-computer coaching programme.

Hypothesis 2: That computers can be used effectively to support the coaching of exploratory talk.

The empirical study of a discussion-based thinking skills programme offered in Chapter 3 showed that exploratory talk could be successfully coached in the

classroom without the use of computers. However it showed four weaknesses of that programme. In the EPIC outlined in chapter 6 computers were incorporated into a larger educational programme in order to overcome those weaknesses.

1) Small group pupil-pupil practice of exploratory talk

The first limitation noted at the end of Chapter 3 was a lack of sufficient 'fade-out'. This lack suggested a need for more pupil-pupil practice of exploratory talk away from the teacher. The evidence of the transcript extracts presented in this section show that computer-based exercises effectively supported exploratory talk between pairs and small groups of pupils.

It might be thought that the group reasoning test also demonstrated effective support for exploratory talk between pupils without the need for computers. This chapter has shown computers supporting exploratory talk within curriculum exercises. A comparison with off-computer exercises with similar educational aims showed a number of ways in which the computer software was more effective as a support for exploratory talk:

- The computer software version of the citizenship exercise was more motivating than the paper version.
- The computer software for citizenship dynamically structured the exercise prompting the children to talk together and preventing them from moving on too fast. The paper version of the same exercise forced the children to provide their own structuring. In one of the two cases observed this failed to work and the children simply read ahead without discussing the issues.
- In the science software exercise the computer served as a shared focus for discussion in the way that the off-computer activity did not. This was evident in the different quality of the talk of the children.

2) Access for all pupils

The second point raised at the end of Chapter 3 was that children did not participate equally in the discussion group. The analysis in chapter 8 showed how the ground rules of exploratory talk in one group of three served to draw all the children together into a community of enquiry. It is easier for quiet children to participate in small groups than in large groups. While the transcripts of the talk at the computer did not show children participating equally in terms of how much they talked they showed all the children in the target class groups participating actively together.

3) Integration across the curriculum

It was suggested that the thinking skills programme observed in chapter three would benefit from being integrated across the curriculum. The evidence presented in this chapter has demonstrated computers being use to integrate reasoning through talk in two very different areas of the curriculum. Similar software could be devised to support exploratory talk in many other areas of the curriculum.

All these points suggest that the use of computer software did play a useful role in a larger programme designed to coach exploratory talk across the curriculum.

Hypothesis 3: That computer supported exploratory talk can serve to integrate peer learning with directed teaching.

The two software exercises were designed to fit closely into the National Curriculum and the curriculum in force in the school (see chapter 6). The teaching aims of the educational activities with the different items of software were clearly specified in advance. In both cases these aims were primarily process aims. In the case of citizenship the main aim was engaging effectively in a moral discussion considering different perspectives and reaching a consensus with others. In the

case of science the main aim was planning experiments, making predictions, relating predictions to observations and explaining these results. A secondary aim was to acquire the terminology required to talk about factors influencing plant growth. In this classroom the achievement of such aims are not normally assessed by tests of any kind but through informal monitoring by the teacher.

The results of the immediate post-tests (interviews) of collaborative learning gains are suspect. The interview situation with a teacher/researcher did not lead to group discussion and so did not accurately assess a group outcome. The views reported as those of the group were often those of one individual in the group who spoke up most. It is perhaps not surprising that some of the children were less expansive in their answers immediately before using the software, which they seemed eager to try, than afterwards with only the prospect of returning to the normal classroom.

Having said that, the group interviews offer clear evidence that the vocabulary used by target class groups to refer to factors influencing plant growth expanded to include the scientific term 'temperature' which was not naturally produced before. This was a key teaching point to emerge from the SPACE projects study of the teaching and learning of Growth in primary classrooms (Russell and Watt, 1990). These interviews also suggested that three of the seven target class group interviewed expanded the moral reasoning about stealing to include the perspective of the victim and of society.

More convincing evidence of learning in the curriculum was provided by the actual talk of the children recorded in transcripts. The transcript extracts presented of target class children talking together at both items of software clearly show them meeting all of the teaching objectives set in chapter 6 except one. The one goal that was not met was the ambitious one of planning a series of fair tests using three variables. This goal was actually somewhat advanced for these

children in terms of where the teacher felt that they were within the National Curriculum Attainment Targets for science.

The episodes of talk which were presented clearly show a computer prompt leading children to discuss the rights and wrongs of stealing and, in the case of science, a computer prompt leading children to relate predictions they have made to results and to plan further tests. This demonstrates that it is possible to use computer software to support the kind of IDRF (Initiation, *Discussion*, Response, Feedback) exchange structure proposed in chapter 5 in order to structure and direct children's active learning through discussion within the curriculum.

9.7 Summary and conclusions

This evaluation combined sociocultural analyses of talk showing learning within the curriculum with computer-based analysis generalising key features of that successful talk across transcripts and between conditions to enable systematic comparisons. In this way talk of children coached in exploratory talk working together at the computer was compared with talk of children who had not been coached and to coached children working at similar educational tasks off the computer. The results indicated that prior coaching in exploratory talk improved the educational quality of talk at the computer and that the computer supported and extended the coaching of exploratory talk by integrating its use across the curriculum. Transcripts were offered which demonstrated the realisation of the possible role for computers proposed in Chapter 5 of supporting exploratory talk while at the same time using prompts to direct it towards serving pre-specified curriculum ends.

Chapter 10 Conclusion

10.1 Introduction

This chapter brings together the main themes of the thesis, summarises its achievements in the form of a series of contributions to research and draws out some of the implications of these contributions for education. The final section puts forward projects for further research which could develop from the research described in this thesis.

10.2 Main themes

The role of computers in education

This thesis began with the question of how best to use computers to promote the development of higher order thinking skills. In the research described in this thesis this question was pursued through several twists and turns and finally pinned down to a particular strategy. That strategy is to use computer-supported collaborative learning as a way of both integrating reasoning through talk into the curriculum and of uniting the curriculum around the central project of promoting the development of communicative rationality. This strategy emerged from conceptual and empirical investigations into the nature of intellectual development and from research on the potential of collaborative learning at computers. It was applied through the development of an educational programme incorporating computers. Evaluation of that programme indicated that the basic strategy worked in improving the quality of learning at the computer, worked in achieving curriculum ends and worked in coaching exploratory talk across the curriculum.

This thesis argues for the value of conceptualising computers as part of the larger communicative process of education. Exploratory investigations in the first part of

the thesis determined the specific educational value of computers as a support for collaborative learning directed towards curriculum ends. In the main study this way of using computers was incorporated into the development of a larger educational programme. A classroom teacher was involved from the beginning of the development process. Software and pedagogy were designed to support each other and to respond to specific curriculum needs. The question of how to integrate computers into the curriculum has been raised by recent surveys of new technology in education (Crook, 1994; Underwood and Underwood, 1990). Both the educational programme incorporating computers which was developed in the main study and the design methodology through which it was developed are put forward as a response to this question.

The significance of exploratory talk

In order to develop a framework for understanding the role of computers in promoting intellectual development, this thesis also had to develop an approach to understanding intellectual development. First the process of acquiring general thinking skills was translated into the sociocultural model of a process of induction into the widespread and centrally important cultural practice of communicative rationality. This was done both through a conceptual critique and through an empirical account of children learning to think. Secondly the educational concept of exploratory talk was introduced as a classroom embodiment of communicative rationality. The underlying structure of this type of talk was specified and methods developed to help in assessing its presence in transcripts. Finally the connection between more established accounts of general thinking skills and exploratory talk was demonstrated through a quasi-experiment which measured the effect of coaching exploratory talk on children's ability to solve problems taken from traditional tests of general reasoning.

Research methodology

In the course of the thesis a methodology was developed to explore the quality of children's talk together and to assess the effectiveness of language-based approaches to teaching and learning. In the exploratory studies the value of coding schemes was questioned and the use of Key Word In Context (KWIC) analysis developed. In the development of the methodology for evaluating the main study computer-based KWIC analysis was combined with both sociocultural discourse analysis on the more 'qualitative' side and the results of test scores on the more 'quantitative' side. This methodology had two aims. Firstly it enabled a relationship to be made between a qualitative assessment of the process of collaboration and a quantitative assessment of the outcome of collaboration. Secondly it enabled assessments of the quality of talk in different conditions to be generalised and compared in a way that maintained a continuous relationship with the content and nature of the actual talk.

Developing a practical educational strategy

All the studies reported in this thesis were concerned with developing guidelines for practice that would be relevant in contemporary classrooms. A thinking skills programme in a primary school was evaluated in order to develop guidelines for the role of new technology in enhancing such programmes. The talk of children working together at computers in normal classrooms was analysed to develop guidelines for the design of both pedagogy and software to enhance the quality of that talk. In the development of the main study two areas of the curriculum were investigated in detail to develop guidelines for the integration of computer-based exercises. A practical educational programme incorporating computers was developed out of the guidelines which emerged from these exploratory studies in order to illustrate and evaluate a practical educational strategy. Although the approach to the use of computers advocated in this thesis has some potentially radical implications it is first of all a practical approach emerging out of studies in

real classrooms and designed to integrate with and improve current classroom practice.

10.3 Contributions

Three claims in the area of educational technology are advanced by this thesis. These emerged as hypotheses in the exploratory phases of the research and were then justified through the findings of the main study. They are:

- That the quality of children's interactions when working together at computers can be improved by teaching exploratory talk.
- That computers can be used effectively to support the teaching and learning of exploratory talk.
- That computer supported collaborative learning can serve to integrate peer learning with directed teaching.

In addition the thesis offers the following contributions to research in the field of education and educational technology:

- An investigation into the role of spoken language in intellectual development.
- A characterisation of an educationally effective type of talk for collaborative learning.
- An investigation into the educational role of computers as a support for collaborative learning and a characterisation of the basic structure of collaborative work with more directive software.
- The development of new methods for the investigation of collaborative learning – particularly the application of computer-based methods to the analysis of classroom talk.

- A set of guidelines for the design of software that can support educationally effective discussion.

10.4 Implications for educational practice

This thesis was intended to offer guidelines for educational practice. Its findings have a number of implications ranging from the relatively modest to the potentially radical.

Coaching exploratory talk

One implication of the findings of this thesis is that children should be coached in how to work together effectively before being given collaborative work. This thesis has specified the type of interaction to be coached – exploratory talk – and an effective series of lessons for coaching it with late primary age children. It has demonstrated that this coaching can work in enhancing the educational results of collaborative learning in the classroom.

The design of educational software to support discussion

The study reported in chapter 5 developed a number of guidelines for the design of educational software to support educationally effective discussion between two or more users. These guidelines were applied in the main study and found to be successful.

A cross-curricular approach to promoting intellectual development

Schemes and programmes to teach thinking skills have shown some evidence of success (Resnick, 1987). Their widespread adoption is discouraged by two related problems. Firstly the problem of combining them with the demands of the current curriculum. Secondly the difficulty of demonstrating an improvement in thinking and in results across the curriculum (Craft, 1993). This thesis has developed, implemented and evaluated an approach to promoting general intellectual

development designed to overcome these two problems. In this programme generic 'thinking skills,' in the form of exploratory talk, are integrated into the teaching and learning process of different curriculum areas through the use of specially designed software. The evaluation of this programme indicated that group reasoning improved significantly, the reasoning ability of some individuals working alone improved and the quality of work in two selected curriculum areas was enhanced. These results suggest that this approach to promoting intellectual development has potential and should be investigated further.

Re-structuring the curriculum

This thesis developed and partially tested a theory of intellectual development which could have potentially radical implications for educational practice. This theory is that the central pillar of intellectual development is induction into the core practice of communicative rationality which, it is claimed, underlies knowledge construction in the different areas of social life. This theory implies that education should focus on drawing children into becoming effective participants in generic communicative rationality as well as into the various specialised versions of communicative rationality found in different subject areas. If accepted this approach to education would lead to considerable re-structuring of the curriculum and of the way different curriculum areas are taught.

10.5 Further research

Having outlined, in the form of contributions to knowledge, the questions that the thesis answered it remains in this final section to look at some of the questions that the thesis raised and at how they might be pursued further. Some of these questions are precise and answerable, others are so broad that they point to the opening up of new areas of research.

Educational software design principles

In Chapter 5 the issue of how to design educational software to support exploratory talk was raised. This is a relevant contemporary issue in software design about which much more research is needed. The publishers of educational software packages frequently claim that their software supports effective collaboration but little work has been done to assess these claims and produce empirically tested guidelines.

The design principles put forward in chapter 5 were implemented in two items of software in two different areas of the curriculum and found to be effective. However the main emphasis of the study was to test and refine a larger pedagogical framework not to test and refine software design principles. The two software items were developed as simply and quickly as possible as prototypes to serve the more theoretical aims of the thesis. This suggests the need for a further more practical and applied research project to concentrate on the effect of different design principles on the quality of the talk of children who have been coached in exploratory talk.

The science simulation proved slightly less effective in supporting extended exploratory talk than the simpler citizenship software. This suggests the need for further studies to assess if this was due to the different software structures, the different pedagogical contexts, or to the different subject areas. This question could be investigated through two short studies. Firstly, through using the same science software but preparing children more carefully beforehand for the particular issue of designing experimental tests with three variables which it was intended to deal with. Secondly through developing new science software using the same branching narrative model as that used for the citizenship software and then comparing its use with the simulation-based model.

It was apparent that a number of children had difficulty reading from the screen. This suggests it might be worth adding an audio component to both items of software and evaluated the difference that this makes. The effect of using high-quality graphics and animation could also be explored.

The same design principles and development method could be used to produce software to support exploratory talk in other curriculum areas in order to explore the relationship between the type of knowledge being taught and learnt and the software design principles.

Developing the use of computer-based discourse analysis

Computer-based methods for the evaluation of the quality of classroom talk were pioneered in this thesis. These methods appear to have potential in educational research. Their use could be expanded in scope and made more effective through further research. The linguistic features of exploratory talk could be more closely specified through further studies of collaborative learning in a variety of settings. It would also be interesting in sociocultural educational research to use these methods to track the transcript contexts in which key terms are used by both teachers and by learners.

Integrating computer-mediated conferencing into the educational programme

This thesis demonstrated one way in which computers could be used to support the coaching of communicative rationality in the classroom. Another approach would be to use the same pedagogical framework and to apply it not to the use of computers running subject specific educational software but to the use of computers as a means to communicate with other children in other schools or countries about curriculum issues. Chapter 2 argued for a link between intellectual development and induction into communities of inquiry. Crook (1994) and Scardamalia and Bereiter (1991) report research on the use of computer

networks to resource and support communities of enquiry in schools. Other research referred to by Wegerif (1995) suggests that computer-mediated communication may be of particular value in supporting communicative rationality. A possible research project on the lines of the main study of this thesis might be to integrate coaching in exploratory talk into the curriculum through the computer-mediated collaborative construction of databases in particular curriculum areas.

A wider implementation

The pedagogical framework outlined in chapter 6 argued for the importance of integrating exploratory talk across the whole curriculum through the use of computers. Due to limited resources and time the programme actually developed and described was only a first implementation of the proposed approach to using computers. A fuller implementation, necessary to judge its potential, would be to select or develop more educational software to be used in all the academic subjects of the curriculum over a period of at least one year. A larger study involving a number of schools would help to separate out the effect of the method from local effects such as, for example, the charisma of a particular teacher.

Further research on language as a social mode of thought

Mercer (1995a) argues that the three types of talk presented in Chapter 4 show different types of social cognition. In Chapter 4 it was suggested that these three types relate to Habermas's attempt to produce a formal pragmatics of language (Habermas, 1979). It was also pointed out that each type seems to be oriented to maintaining a different level or type of identity. Disputational talk is oriented to the individual level, cumulative talk to the group level and exploratory talk projects an ideal or universal level. This raises some fascinating but very difficult questions. Do these three types of talk represent a universal framework? What is the relationship between the use of these types of talk and the development of

self-identity? Is the 'ideal community' (Habermas, 1979) implicitly projected by the use of communicative rationality a specific cultural ideal or an emergent property of the pragmatic requirements of communication?

Much more research is required to understand the connection between types of communication and cognition. This thesis made a small start in demonstrating a connection between established ways of measuring general reasoning ability in education and the use of exploratory talk. It would be of value to pursue this with a larger inter-disciplinary study of the roots of rationality in language use starting with a survey of relevant research in the areas of social anthropology, applied linguistics and philosophy.

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234 - End	APPENDICES